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# ANTIQUITY OF MAN IN WESTERN EUROPE.

BY EDWARD CLODD.

PART IV.

KENT'S HOLE, or Cavern, lies in a hill in the vale of Ilsham, about a mile eastward of Torquay harbour, and half-a-mile from the coast. It comprises, as the openings in the face of the cliff indicate, two caverns which run parallel with each other, widening here and there into chambers to the extreme limit, when a passage connects them. An inscription in one of the chambers, known as the "Cave of Inscriptions," shows that some curious traveller had wandered into its recesses nearly 200 years ago, and it was partially surveyed in 1825 and following years; but it is to the systematic research and unceasing superintendence of Mr. Pengelly since 1865 that we owe that full knowledge of its contents from which irrefragable conclusions concerning the high antiquity of man in this quarter of the globe are drawn.

Entering the eastern division, to which the labours of Mr. Pengelly and his committee have been restricted, we find the deposits to occur in the following order, beginning with the uppermost:—

NEOLITHIC.—1. Blocks of limestone, weighing from a few pounds to upwards of 100 tons, which have fallen from the roof under the action of frost, &c., and of which many are cemented together by carbonate of lime, *i.e.*, stalagmite. 2. Black muddy mould, from three inches to as many feet in thickness; composed almost entirely of decayed vegetable matter.

PALÆOLITHIC.—3. Granular stalagmite, varying in thickness from a few inches to five feet. 4. Layer of charred wood, about four inches in depth, but occurring in one part of the cavern only, near the entrance. This is known as the Black Band. 5. Light-red loam, called the Cave-earth, the actual depth of which, throughout, is unascertained, as the examinations have been limited mainly to a depth of four feet beneath the stalagmite. 6. Crystalline stalagmite, from three to twelve feet thick. 7. Dark-red sandy deposit quite free from limestone, in which quartz pebbles and fragments of grit are imbedded. This is called *breccia*.

In conveniently classifying these deposits by the animal remains found in them, Mr. Pengelly calls the two uppermost (which are included in Neolithic times) the *Ovine* period, because the sheep is never found below them, all the bones being those of animals still extant. The three deposits immediately below these, numbered 3, 4, and 5 in the above list, he call the *Hyænine* period, because the bones of that animal predominate. The two lowest deposits he calls the *Ursine* period, because bones only of the cave-bear are found in them. Passing through the black mould, the varying contents of which lie within the province of the antiquary, we reach the uppermost layer of the Hyænine period, the bed of granular stalagmite. Mingled with the remains of various animals, more or less extinct, as the mammoth, cave-bear, cave-hyæna, etc., with shells of cockles and cuttle-fish, with charred wood and rounded pebbles; we find herein flint-flakes, implements, and cores, or flint-nodules from which flakes have been struck; and, at a depth of twenty inches, a portion of a human upper jaw, containing four teeth, together with a fifth tooth lying near it.

The black band, the site where the cave-men kindled their fires for cooking, or perchance for warmth and for scaring wild animals, contained about three hundred and fifty flint flakes and cores, an abundance of charred wood, a bone awl, bone harpoon, and needle with a well-formed eye (in the Dordogne caves the stone implements were found with which the eyes were drilled in the needles), and the remains of rhinoceros, cave-hyæna, horse, ox, bear, &c.

The cave-earth was richest of all in the number of stone implements, and the abundance of teeth and bones. The flint implements were of a markedly higher type than those of the Drift, and, in their variety, suggestive of cave-man's fertility of resource, as compared with his predecessors, for the list includes well-worn stone hammers and whetstones, a bone pin, and barbed harpoons. The crystalline stalagmite contained bones of the cave-bear only, but in the breccia, there were found, mingled with remains of that animal, implements of flint and chert, "much more rudely formed, more massive and less symmetrical in form than those obtained from the cave-earth and black band," and made, Mr. Pengelly adds, "by operating, not on flakes, but directly on nodules, of which portions of the original surface generally remain."

Before making brief reference to contents special to the bone-caverns of the Continent, it should be asked how the above bears out what was said in the first paper of this series concerning the enormous duration and remoteness of the ancient Stone Age. Of its remoteness we find sufficing evidence in the deepening of the valley to the extent of between 60 and 70 ft. since man and his congeners had refuge in Kent's Hole, while the period demanded for this scooping out is itself limited when compared with the time required for the successive deposits in the cavern, and for the intermittent interruptions which they suffered by the streams of running water which, as the layers of loam and sand, with their enclosed pebbles, show, now and again entered the cave, disturbing the older deposits.

At first sight it may appear that an easy method of getting rough measure of the time involved in the deposition of stalagmite is at hand in watching the rate at which it goes on now. But no such criterion serves us, because the rate at which stalagmite accumulates varies extremely, being determined by states of climate, by air currents, by the quantity and quality of the water, by the greater or lesser porosity of the rock in course of dissolution, and other causes, marked variations of rate occurring even in the same cave. "In the Ingleborough cave, in Yorkshire, it has been so swift that between 1845 and 1873 a stalagmitic boss, known as the Jockey Cap, has grown at the rate of ·2941 inch per annum;" but such a rate is exceptional, as otherwise our caves would speedily have been filled up with such accretions.

XUM

That inscription (one among others) in Kent's Hole, to which reference is made above, does, however, help us somewhat in the matter. On a large boss of stalagmite, which rises from the floor, and which has been subject to the continuous drip of lime-charged water from the roof, this inscription is yet clearly to be read: "Robert Hedges, of Ireland, Feb. 20, 1688." Evidence of its genuineness is at hand in the description of it left on record by the Rev. J. MacEnery, who explored the cavern in 1825. He says that "the letters are glazed over, and partly effaced," showing that they had not been recently cut. That description applies accurately to them now, after the lapse of sixty years. Now, the film of stalagmite over these is about one-twentieth of an inch in thickness, and the like applies to still older inscriptions, in another chamber, round the "Crypt of Dates," the genuineness of which inscriptions there is no reason to doubt.

If we take as our standard of reckoning the rate at which the stalagmite has accumulated on the Hedges boss and apply it to the bed around it, which is in places five feet thick, we get a result as startling as it is probably excessive, because we have assumed uniform climatal conditions throughout. True, in his notice of the last edition of Lyall's "Antiquity of Man," Mr. Alfred Wallace, an authority not given to over-estimate, remarks that the sum of half-a-million represents the years that have probably elapsed since flints of human workmanship were buried in the lowest deposits of Kent's Cavern,"* and after allowing a far more rapid rate for the formation of both the crystalline and granular stalagmites (to say nothing of intercalated deposits) than the evidence warrants, the estimate which demands the lapse of tens of thousands of years since the entombment of rude flakes in the breccia cannot be gainsaid. Some words of Mr. Prestwich, in a paper read before the Royal Society, and which Mr. Pengelly has already happily quoted, may be repeated here. He says that, "just as though ignorant of the precise height and size of a mountain range seen in the distance, we need not wait for trigonometrical measurement to feel satisfied in our minds of the magnitude of the distant peaks, so with this geological epoch; we see and know enough of it to feel how distant it is from our time, and yet we are not in a position at present to solve with accuracy the curious and interesting problem of its precise age."

## HOW TO GET STRONG.

### III.—THE CHEST (*continued*).

A CORRESPONDENT asks how the calf-skin bag (or dumb-boxer) should be made, and how large it should be. There is no rigid rule as to size, or material, or make. A disused hair pillow, doubled and tied up, will serve very well. But, if you take nine or ten spindle-shaped pieces of calf-skin about 5 in. broad and from 18 in. to 2 ft. long, and sew together, they will form a bag which, filled with sawdust or stuffed with hair, will be somewhat handier for boxing at.

The exercises for expanding the chest hitherto considered (running, boxing, and inhaling to the full extent of the lungs) produce their effect chiefly in an indirect manner, so far as the expansion of the chest is itself concerned, though in a very direct manner as regards the act of breathing: the chest is made to expand because the lungs are expanded, either by the deep and quickened breathing resulting from rapid movement, or by the actual drawing in of air in large quantity. We have now to consider exercises which act directly to expand the chest, and thus help the breathing-apparatus indirectly, by giving it room for freer action. For this purpose all exercises are good which carry the arms well over the head, all those which carry the arms out horizontally backwards, and all those which bring the elbows close into the side *with a backward motion of the shoulders and upper arms.* These last words must be specially noticed. Rowing, a capital exercise for many purposes, is *not*, as is commonly thought, a good exercise for the chest; for though at the finish of the stroke the elbows are drawn close in to the sides and carried backwards as far as possible, the shoulders and upper arms are kept rather forward and drawn rather towards each other, on account of the position of the hands on the oar, and also because in hard rowing no strength can be spared for a useless backward swing of the shoulders. In steady rowing for pleasure, the hands may be set a little further apart, and the shoulders thrown well back at each stroke with great advantage, so far as the health value of the exercise is concerned. Rowing in this way is delightful, though not at all suited for racing.

Beginning with chest expansion by exercises taking the arms over the head—the best exercises of all for increasing chest-capacity—we note that there are scarcely any but artificial exercises nowadays for this purpose, that is, there are scarcely any exercises which thus work the arms, as rowing, boxing, fencing, &c., work them in other ways, or as walking and running work the legs. Climbing ropes is a rather severe form of this sort of exercise, not readily to be practised by most persons, and too severe for men past or nearing middle life, when the body is generally too heavy. The strain on the deltoid muscles tells heavily before much good has been done in the way of chest expansion. There is the same defect in hanging exercises on the parallel bars, or on the trapeze. These are for athletes, and even with them, more for the strengthening of the deltoid and other special muscles than for the expansion of the chest.

Rather oddly, we receive just here, through the Editor, a note from Sir Edmund Beckett, running as follows:—

> I do not know whether the writer on "How to get Strong" will care to hear that I know no exercise which tends so much to expand the chest as bell-ringing, being performed standing quite upright. I used to ring the heaviest bell in peals, at Cambridge and elsewhere, when I was young, and the nine o'clock at St. Mary's nearly every night, and I used always to feel that result. E. B.

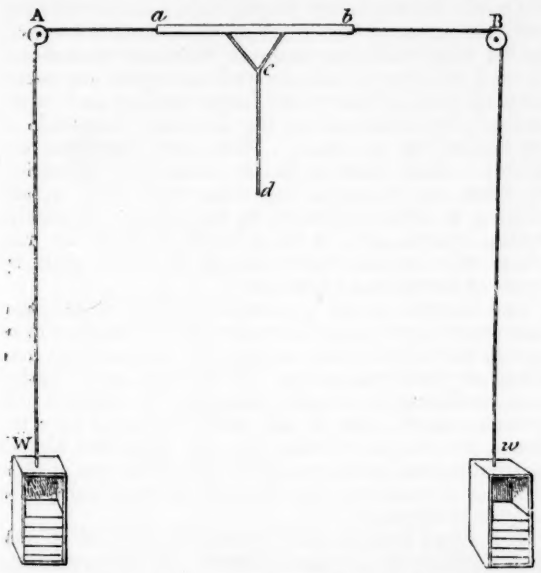
Bell-ringing would be just the sort of exercise wanted to open the chest: for here, the hands being close together (instead of acting, as in rowing, to contract the chest) acts—at the most effective moment—to expand it. The construction we were about to describe for arm-above-head exercise to expand the chest, can very readily be used to give an effect akin to that obtained in bell-ringing—which is fortunate, because only a limited portion of the community can ring bells. (For 1,000,000 able-bodied men in London to get each half-an-hour's bell-ringing—peals of eight—per day, it would be necessary that there should be constant pealing from 2,600 steeples!)

Let A, B (Fig. 1) be two pullies high up, on the same level, against one of the walls of a room, W and *w* two weight boxes (of course, mere weights will do) *a* AW, *b*B*w* stout cords passing over the pulley and connecting *a* and *b*, the two ends of a stout rod *ab* (a broom-handle will serve) to the weight boxes, W, *w*. The short cord, *cd*, is simply for drawing down the rod, *ab*, till the upstretched arms can reach it.

Now let the rod *ab* be grasped overhead, the arms being vertical, and therefore the hands separated by the breadth

* *Nature*, Oct. 2, 1873.

of the chest. It is best to stand with the back to the wall. Draw *ab* steadily down, till the hands and arms are in about the position they have just before the feather in rowing; let the bar go steadily up again, to your full reach. Continue this exercise about five minutes, being careful to let the arms be drawn up to their full reach above the head each time. The weights at *W* and *w* may at first only be some 10 lb. each (so that the heavier dumb-bells tied at *W* and *w* will serve very well), but can be gradually increased as the arms gain strength: though this




is not, be it noticed, the object of the exercise. For mere muscular work they might be increased until each amounted to nearly half the weight of the body; but this would not do for work in chest expansion. In this exercise draw in the breath fully as the bar rises, hold it till you cannot comfortably hold it much longer, then begin to draw down the bar *ab* slowly, breathing out slowly as you do so, and after you have drawn the bar to its lowest position—just opposite the lowest part of the breastbone—breathe out the last particle of air you can get rid of without drawing your shoulders forward. In this way you will get most benefit from each pull, so far as chest expansion is concerned. But if you want more active muscular work, expand your chest fully when the bar is at its highest, and then pull it down and let it up steadily as often as you can without letting out your breath, which you can finally do in drawing the bar down, taking in a full breath as it rises again. Or you may take several pulls after exspiring before taking in another full breath. Only note that you ought always to let inspiration be completed when the bar is at its highest, exspiration being completed when the bar is at its lowest.

Now take advantage of Sir Edmund Beckett's useful hint. Lay hold of the cord, *cd*, near *c*, at your utmost upward reach, and pull downwards, as if ringing a heavy bell. You can continue the downward pull till the hands, close together on the rope, reach about to the abdomen. Repeat these pulls, breathing in any one of the ways described in the last paragraph, for from five to ten minutes. You will find (we have tried it, and know*) not only advantage to your health, but absolute physical pleasure in this exercise. We have never taken part in bell-ringing, but we can now very well understand how this exercise, combined with the pleasant noise of well-matched bells, should have been regarded by the Puritans as a sinful recreation — somewhat only on the principle which led some one to say that the only thing wanting to make strawberry-eating perfect was that it should be forbidden. We never before thoroughly understood that passage in Bunyan's life, in which we are told that, "having been mightily addicted to ringing, he was very unwilling, for all his reformation, to leave it; but his conscience beginning to be tender, he thought the practice thereof to be but vain, and so forced himself to leave it, *yet could not keep his mind from hankering after it.* But then he was surprised with fears that possibly one of the bells might fall and kill him, so that he durst no longer go into the steeple, but would stand at the door; and even then he was afraid lest the steeple itself should fall upon him." Yet, says the worthy chronicler, "this was only lopping off the branches of sin while the root of unregeneracy remained."

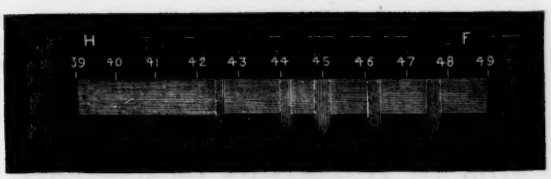
*(To be continued.)*

* The reader will excuse us for not saying, as usual, *Crede experto.*

## PHOTOGRAPHIC SPECTRUM OF COMET (WELLS.)*

By DOCTOR W. HUGGINS, F.R.S.

ON May 31 I obtained a photograph of the spectrum of this comet, with an exposure of one hour and a quarter. On the same plate I took a spectrum of α Ursæ Majoris for comparison. The comet's spectrum on the plate consists of a strong continuous spectrum extending from about F to a little beyond H. I am not able to distinguish any of the Fraunhofer lines in this continuous spectrum. The slit was rather more open than was the




case in photographing the spectrum of the comet of last year; this would make these lines less distinct, but the lines G and H are well seen in the star's spectrum taken under the same conditions. We may therefore conclude that the part of the comet's original light which gives a continuous spectrum is much stronger relatively to the reflected solar light in this comet, than was the case in the comet of last year, and for this reason the Fraunhofer lines are not distinguishable.

Observations of the visible spectrum had already shown that the comet differs remarkably from the hydro-carbon type common to all the comets, some twenty, which have appeared since spectrum analysis has been applied to these bodies.

The photographic spectrum shows, as was to be expected, that this essential difference of spectrum exists also in the more refrangible region. The very strong ultra-violet group assigned to cyanogen is not to be seen on the plate, and the bright groups between G and *h*, and between *h* and H do not appear to be present.

* Substance of note read before the Royal Society, June 15, 1882.

XUM

The head of the comet was in sharp focus upon the slit, and the continuous spectrum with defined edges corresponds to the nucleus, which in this comet was very distinct. In this continuous spectrum at least five separate places of greater brightness are seen, which very probably represent groups of bright lines, though they are not sufficiently distinct in the photograph to admit of resolution. That this interpretation is correct, seems probable, from the circumstance that these groups, as shown in the diagram, project beyond the strong continuous spectrum on one side. The side corresponds to where the light of the coma, on the side of the nucleus next the sun, falls upon the slit. We learn, therefore, that the light of this part of the coma consists for the most part, in this part of the spectrum, of these groups, as here on the plate only an exceedingly faint continuous spectrum can be seen.

It is not possible to measure with any useful accuracy the beginnings and endings of the groups, as they are too faint at these points. Measures as accurate as the circumstances would permit have been taken of the brightest parts of the groups. The wave-lengths of these brightest parts are:

λ 4253
λ 4412
λ 4507
λ 4634
λ 4769

In the visible spectrum the bright lines of sodium appear to have been strong, and it may be that some of the light of some of the groups may be due to this substance.

Professor A. Herschel and Dr. von Konkoly showed long ago that the spectra of the periodic meteors are different for different swarms, and it does not seem surprising that we have now a comet, the matter of the nucleus of which under the sun's heat shows an essential chemical difference from the long series of hydrocarbon comets which have appeared since 1864.

Mr. Hind has kindly furnished me with the distance of this comet from the sun at the time the photograph was taken. The comet was then 42,380,000 miles distant from the sun, while the comet of last year was 69,420,000 miles [distant] when I obtained the photograph of its spectrum.

## AIDS TO THE STUDY OF GEOLOGY.

By W. JEROME HARRISON, F.G.S.

AT the request of the Editor I have undertaken to contribute a series of geological papers to KNOWLEDGE. These papers will take the form of accounts of visits made to places of geological interest, especially to such as are well-known holiday resorts, and are easy of access. I shall also give an account of the geology of some of our great towns, showing what may be learnt by a study of the stones used in them for building, paving, &c., and what natural sections are exposed in their immediate neighbourhoods.

In this preliminary paper I shall describe the apparatus, books, &c., which are required for use in the field or in the study, by those who desire to investigate the rocks.

APPARATUS FOR FIELD-WORK.—A good *map* is indispensable. The geologist should provide himself with both the plain map (Ordnance Department, Quarter-Sheets, 1s. each) and the coloured map (Geological Survey, Quarter-Sheets, 3s. each). The former will give him the hills, while the latter will show where the various beds of rock occupy the surface. Each quarter-sheet should be mounted on linen, so as to fold into six; it can then be conveniently carried in the pocket. Catalogues of the maps and other publications of these two Government Departments may be obtained from Stanford's, Charing-cross, and from these the particular maps required, according to the district to be examined, can be selected.

Another necessary article is a *hammer*; the head should weigh about one-and-a-quarter pounds, and have a square face, made of mild steel; the handle is best made of ash, and should be divided into inches, so as to serve as a measure. The shape and weight of the hammer will vary with the nature of the rocks on which it is to be used; for old tough rocks, like those of Wales, the head should be short and heavy; while for work among soft and easily-splitting beds a lighter and longer hammer-head is desirable. The wedge-end of the hammer is best made at right-angles to the shaft. When rock specimens are desired, a light trimming-hammer should also be carried, to reduce the specimens into shape in the field. A *cold chisel* is a useful companion to the hammer; it enables fossils, crystals, &c., to be detached, without the risk which often attends their removal from the rock by means of blows from a hammer.

The hammer should be carried by means of a leather belt, provided with a slit through which the handle may be passed, and a leather flap to keep the hammer-head from soiling or chafing the clothes. To the belt a small leather case, containing a *compass*, may also be attached. A geologist cannot keep to the roads, and must have the means, not only of steering his own path, but also of ascertaining the direction in which the rocks run, or their *strike*, as it is called; and for each of these purposes a compass is necessary.

It is a rare thing in this country to see a bed of rock lie horizontally for any great distance; any railway cutting or quarry will usually show the strata slanting or *dipping* in some direction or other; the direction may be ascertained by the compass, but to measure the degree, or *angle of dip*, we use an instrument termed a *clinometer*. By hanging a little pendulum to the central point, marking degrees on the circle, and adding a short, flat base, we can make the compass serve also as a dip-measurer, or clinometer. This form of instrument, complete in leather case, is usually sold at one guinea; but a much cheaper clinometer can be made by drawing a graduated semicircle on a thin, flat, oblong piece of boxwood, and pivoting a brass pendulum at the centre of the arc.

The *Wallet*, or *Bag*, must not be forgotten, for an enthusiastic geologist seldom fails to meet with many specimens, in the course of a day's outing, which he will desire to take home for further examination, or to add to his collection; a leather game-bag answers capitally when at work among the igneous or slaty rocks, whose weight and sharp angles rapidly cut through anything less tough than leather. The satchels made of a stout brown material which are much used to carry school-books in, also make capital collecting-bags. A good supply of brown paper should be provided, so that each specimen may be wrapped up separately, while, if fragile shells or delicate crystals are likely to be obtained, some chip-boxes and cotton-wool must also be taken. To identify specimens it is best to carry gummed strips of numbers; these should be detached, one by one, and affixed to each rock or fossil at the time it is obtained, an entry being made at the same time in a note-book of the locality and exact position whence the specimen was derived, with any other particulars of interest.

Many geologists always carry a little dilute *hydrochloric acid*, in a small stout bottle, in order to be able to identify

any *limestone* they may meet with; the effervescence which results when a drop of this acid is placed on any rock is a sure sign that it contains a large proportion of carbonate of lime. Lastly, a *pocket magnifier*, provided with two lenses, will be needed to examine finely-grained rocks, or to scan their surface for minute fossils.

Let no one, however, think that all the above articles are indispensable to good geological work; the fact is that while they are all *useful*, they are none of them absolutely *necessary*. I have known a working-man, armed with nothing better than a coal-pick, to acquire a knowledge of the rocky structure of the district in which he lived, which has enabled him to lend valuable assistance to the Government surveyor.

APPARATUS FOR HOME-WORK.—A good *microscope* is much to be desired, and I can recommend the instrument specially designed for geological work by Mr. Swift. It is now very much the fashion to make thin *sections of rocks*, especially the igneous rocks, so as to determine, microscopically, the minerals of which they are composed; an excellent machine has been invented for this purpose by Mr. Jordan; but this costs from £8 to £10. By cementing chips of rocks to strips of glass, it is possible to rub them down by hand—first on an iron plate with emery and water, and afterwards on a water-of-ayr stone with water only, until they acquire the necessary thinness and transparency; the process is a tedious one, but a Lancashire working-man has in this way made hundreds of beautiful sections of the fossil plants of the coal-measures. A *cabinet* to keep specimens in may often be picked up second-hand; the drawers should measure about 20 in. by 15 in., and should vary in depth from 1½ in. to 4 in.

BOOKS.—The best general text-book for beginners is Lyell's "Student's Elements of Geology" (Murray); to this we may add Rutley's "Mineralogy" (Murby), and "Study of Rocks" (Longmans).

NAMING OF SPECIMENS.—Book knowledge alone is of little real value to the geologist. He must learn to recognise (1) minerals, (2) rocks, (3) fossils. To do this it is absolutely necessary to carefully examine correctly-named specimens. The dweller in London must visit the geological museum in Jermyn-street and the new Natural History Museum at South Kensington for this purpose. Named collections, or single specimens, are sold by many dealers, among whom I have long known Mr. Gregory (Charlotte-street, Fitzroy-square) to be thoroughly reliable and trustworthy. By far the best work on the study of fossils is Professor Nicholson's "Palæontology" (Blackwood), but no one must expect to make much progress in the study of fossil shells—or, indeed, any extinct forms—unless they first study, to some extent, the living species.

In my recently-published book on "The Geology of the Counties of England" (Kelly & Co.), I have given lists of the more important books and papers on general geology; and have also prefixed lists of local papers, maps, and books to the articles on each county.

There are two great libraries of geological books in this country, and of each of them a catalogue has recently been published. The library of the Jermyn-street Museum includes about 28,000 volumes. To consult the books, permission must be obtained from the curator, Mr. F. W. Rudler, to whose kindness and courtesy I, like many other workers in geology, can bear willing testimony.

The library of the Geological Society of London is lodged in Burlington House; it may be inspected by obtaining an introduction from a Fellow. Provincial libraries are, almost without exception, extremely deficient in geological works. Even the volumes of the Palæontographical Society, in which all the British fossils are being figured and described, are hardly to be met with on the shelves of one public library out of ten! Of the "Transactions" and other publications of the local scientific societies of Great Britain, I do not believe there is a complete set in any library whatsoever.

But, besides the study of specimens at home, there is much geology which can only be learnt by looking at the rocks on a grand scale in the field. It was said of Murchison that "he had a fine eye for a country," and it is the acquisition of this power of reading the surface features of any landscape that we should strive to obtain. No district can be uninteresting, or can fail to furnish useful employment to a true geologist. The pleasure of understanding the causes which have produced our English scenery doubles the delight arising from its contemplation, and when, after viewing the rocks from a distance, we interrogate them closely in the quarry or on the hillside, we shall learn from them the history of the past, told without possibility of error, and with a fulness according to our powers of interpretation.

## ENGLISH SEASIDE HEALTH-RESORTS.

BY ALFRED HAVILAND, M.R.C.S., F.R.M.C.S. Lond.

CLASSIFICATION (*Continued from page* 53).

BEFORE leaving the subject of the effect of latitude on the climate of the sea-coast, it will be well to refer to an opinion entertained by many against the more northerly health-resorts. It is supposed that because they are so many miles north of London and other large towns, that they necessarily must be cold, exposed, and unfitted for some cases—for instance, the consumptive. A more erroneous notion could not be conceived; moreover, it is one that operates prejudicially in two ways: it prevents many from deriving benefit from their pure and bracing climates, and acquiring that physical and mental tone so conducive to the prevention of the development of their latent disease; whilst it misleads them to the more Southern resorts, the mild, balmy atmosphere of which is often a short salvation to those whose disease is developed, but impotent to give the necessary vigour to the young, who hope to conquer their disease, and eventually live anywhere. That the Northern part of the English coast, and especially on the north-eastern side, has a climate in which consumption (Lat. *Phthisis*) does not thrive, may be shown by the low mortality from this cause, which characterises this part of the country, and forms so remarkable a group in the map whereon the geographical distribution of this disease is portrayed.

If we look at a map of England, we shall see that its triangular form favours, in a striking manner, the preservation of the insular character of its climate, for it tapers from its southern base, or from the fifty-third to the fifty-fifth degree of north latitude, and thus enables the seas on its western and eastern coasts to approach each other, and to increase the insularity of this area almost in the direct ratio of its receding from the south. If we enclose England within an area, the limits of which are defined by the longitudes 5° 45′ W. and 1° 46′ E. (those of the Land's End and Lowestoft), and the latitudes 50° and 56° N., and divide it into six interlatitudinal zones or belts, we shall be able to judge, accurately enough for our purpose, as to the relative proportion of land to sea that obtains within each zone.

Such an area, if the width at the northern boundary be made equal to the southern, instead of following the

meridians (which grow closer to each other as they approach the north) would represent about 137,444 square English miles; each zone would therefore contain about 22,907 square English miles. The distances between the parallels of latitude are longer than at the equator. The average, however, of 69½ English miles has been taken, and this would give in round numbers 23,000 square English miles to each zone. We shall now be able to estimate the proportion of land and water within each zonal area.

| Interlatitudinal Zones. | | Number of English Square Miles of | | | Percentage of | |
|---|---|---|---|---|---|---|
| | | Land. | Sea. | Zone. | Land. | Sea. |
| I. | 56°—55°N. | 8,750* | 14,250 | 23,000 | 38·0 | 62·0 |
| II. | 55°—54° | 7,100† | 15,900 | 23,000 | 30·8 | 69·2 |
| III. | 54°—53° | 9,450 | 13,550 | 23,000 | 41·0 | 59·0 |
| IV. | 53°—52° | 18,500 | 4,500 | 23,000 | 80·4 | 19·6 |
| V. | 52°—51° | 15,600 | 7,400 | 23,000 | 67·8 | 32·2 |
| VI. | 51°—50° | 6,550 | 16,450 | 23,000 | 28·9 | 71·1 |
| | | 65,950 | 72,050 | 138,000 | 47·7 | 52·3 |

* Scotland 6,900 and England 1,850 s.m. † Scotland 750 and England 6,450 s.m.

The above figures will demonstrate the remarkable difference that exists between the several zones into which the area has been divided. The percentage columns show that the whole area has more sea than land; that between the IV. and V. zones there is to be found the greatest amount of land; that the most southern (VI.), and one of the most northern (II.) have the most perfect insular character, and that the four central zones differ widely; for instance, the two northern zones II. and III. have an immediate sea area of 29,450 square miles, whilst the two below them, IV. and V., have only an immediate sea area of 11,900 square miles. This large additional amount of sea surface, close to the north-eastern and north-western coasts, which, between these parallels, are nearer to each other than at any part of the east and west coast lines, has a powerful influence not only on the climate of the coast, but on that of the interior; this influence is more evident during the periods of extreme heat and cold, as in January and July, when the weak most require it. In the winter, when the Gulf Stream tempers our climate, these, as it were, extra 17,550 square miles of sea, bring closer home its warmth, and in this way reduce the daily range of temperature. In the summer, the small area of land lying between the two seas has its sun heat cooled by them, so that an insular climate becomes as perfect in the north as it is found to be in the south.

Many of the above facts, now that they have been given in detail, may be rendered still more evident to the eye by means of chart diagrams, with one of which we hope to illustrate, next week, some of the points dwelt upon in former pages. The six zonal areas we have thus described will serve our purpose admirably for grouping together our Seaside Health-Resorts; for each belt of land and sea has its characteristic climate factors, and each its physical peculiarities; each its distinctive surroundings; and we shall see how these operate in producing that variety in our climate which has rendered it so difficult a study.

We shall have, in the next place, to consider the position of the Seaside Health-Resorts on the seaboard, and point out how their climates are affected by the Gulf Stream, the North Sea, and the Continent of Europe.

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ELECTRIC LIGHT IN A SALT MINE.—The Witton Hall Salt Mine in Warrington-road, Northwich, is now lighted up by Brush lamps in place of the candles generally used. There are sixteen large arc lamps employed.

# FUTURE SOURCES OF OUR FOOD SUPPLY.

BY PERCY RUSSELL.

## AUSTRALASIA.

AT a time when, as a nation, we are becoming increasingly dependent on foreign supplies for our "daily bread," and when there seems no prospect whatever of the home producer again meeting in any adequate degree the wants of the home consumer, it is surely equally profitable and interesting to inquire into the nature and extent of the resources beyond the seas which exist for the due provisioning of these over-peopled islands.

In truth, the national commissariat has important social and even political bearings which appear to be unduly slighted by many among us, while in its industrial and commercial aspects it is obviously of transcendant importance.

Most persons are aware, as a mere matter of general information, that we now draw a great portion of our bread stuffs from the United States, and it is known, too, that many items of dairy produce reach us from the same source, while France furnishes us with no inconsiderable part of the fruit and vegetables which might, in a great many cases, be grown by ourselves.

In effect the British islands are now, to a certain extent, regularly victualled from extraneous sources, and as the requirements of a people who are ever becoming more and more concentrated in towns and cities, constantly augment, the food importer is ever on the look out for new fields whence he may draw his enormous supplies, and thus, by introducing fresh factors into the commercial calculation, defeat the designs of those who look to monopoly for forcing up prices.

Enough has been written about the vast wheat-fields of America, and the great resources of Canada and the west of our North-American dominions, but I do not think that persons here not directly connected with our Australasian colonies have any adequate notion of their real capabilities for provisioning this country, or of the happy and mutually beneficial result that must ensue from a more complete interdependence of these islands and the great Austral continents.

I propose in this paper to give a rapid sketch of Australasia as a sufficient source in the future for all such food staples as we may need, and to show by facts and figures that in settling these remote regions of the southern hemisphere, we have unconsciously obtained a safeguard against the very possible and appalling peril of any combination that might be effected in the United States for the purpose of extorting ruinous rates on account of our evident inability to supply our own people with food.

On the one hand we have within the contracted area of these islands a population of something like 40,000,000 all told, cultivating about 3,000,000 acres for wheat, and owning, in round numbers, 10,000,000 head of cattle, 27,000,000 of sheep, and 3,000,000 of pigs, and having a trade valued at about £697,000,000. On the other hand we have an area, some 3,000,000 square miles, *i.e.*, twenty-six times the size of Great Britain, occupied by a population of less than 3,000,000, raising, on an average, nearly 40,000,000 bushels of wheat, possessing over 8,000,000 of cattle, 75,000,000 of sheep, and 1,000,000 of pigs, while the aggregate trade of this community—rich in corn and cattle up to scriptural standards—amounts to close on £100,000,000 per annum! If we carefully compare, then, the outcome in material well-being and in diffused general wealth, of the scanty Australasian com-

munities with our own over-populated country, we cannot fail to be struck by the marvellous way in which, at the antipodes, production has outstripped population and given to progress a true cornucopia running over with an abundance of the good things of this life.

Clearly between two such communities reciprocity should exist in the fullest and most generous sense of the expression, and thanks to many happy causes, among which the great acceleration in steam navigation is one of the chief items, this reciprocity does exist in a large degree, and unless our statesmen, in dealing with these nature-favoured colonies, commit some extraordinary fiscal or political blunders, we may fully rely in the future on the readiness and ability of our Australian cousins to make good the shortcomings of our corn-fields, our stock-yards, our sheep-folds, and even of our orchards.

Let us examine in detail, then, the true character and extent of these Australasian resources in all their home-bearing aspects. Turning to the parent colony, New South Wales, we find that the total area includes 198,626,143 acres, or, in other words, it is about the size of England and France combined. It is within bounds to assert that everything produced in England can be grown in new South Wales, including—besides the familiar fruits of the temperate zone—oranges, lemons, figs, &c. During the latest year for which we have comprehensive statistics, 252,540 acres were under wheat, yielding nearly 4,000,000 of bushels, while over 50,000 tons of good potatoes were also raised, to say nothing of oats, barley, rye, sugar, and grapes, which last gave 584,000 gallons of excellent wine and 6,600 gallons of good brandy. This is, however, not all. There were, at the period in question, 706,498 acres under cultivation, and no less than 21,351,433 enclosed ready for agricultural operations, while some 6,000,000 acres lay outside ready to be brought within the productive pale.

The stock returns were no less remarkable. We find that there were on March 31,1881, of horses 395,984; of horned cattle 2,580,040; of sheep 32,399,547; and of pigs 308,205. Such were the resources, roughly speaking, in bread, beef, and mutton of only a single member of the great Australasian group, and at the date in question the population, all told, was but 503,981 souls. The figures relative to the live stock resources are of great moment, for the requirements of Great Britain in the way of butcher's meat are computed to reach over 600,000 tons per annum, a quantity constantly increasing, be it observed. It is generally admitted that in England the meat consumption per head is full 120 lb. per annum, and it is well known that we do not ourselves produce 80 lb. of this amount. The difference has, therefore, to be made good from alien sources. To fill up the deficiency requires full 20,000,000 of sheep, and here we find that a single colony—New South Wales—can very nearly accomplish this tremendous commissariat feat unaided, and still feed her own people. New South Wales, however, is by no means Australasia, as we shall presently perceive. Let us now turn to the most highly civilised and, to borrow an apt scientific phrase, differentiated of all the Australasian communities—Victoria.

THE JABLOCHKOFF LIGHT.—The contract for illuminating the Avenue de l'Opéra with the Jablochkoff candles has been renewed by the municipality of Paris for three years. Power has been granted, in connection with this new contract, to introduce the light into the houses in the district.

WATER POWER AND THE ELECTRIC LIGHT.—It is rumoured that a wealthy company is making arrangements to buy the water power at Harper's Ferry, on the Upper Potomac river, with a view of lighting Washington city and Baltimore by the electric light.

## Reviews.

### SHAKESPEARE STUDIES.*

EVERY Englishman ought to study Shakespeare till, as far as in him lies, he knows him well. When certain passages not corresponding with our present ideas are omitted, the same may be said for every woman, and for the young folks, too. We want Shakespearean teachers for such study: so that the splendour of Shakespeare's gift to his people and to the world, to his age and to all time, may be rightly seen, while yet the spots on that splendid sun may be recognised also. But, thus far, most of our teachers—nearly all of this present day—are word-carpers, metre-measurers, comma-counters, allusion-hunters, and antiquarian note-gatherers. They do good service in their own way, but it is not the kind of service which is chiefly wanted. It is interesting to know that the poet we have learned to love as Shakespeare spelt his own name Shakspere, and probably pronounced it Sháx-per; to learn that in "Love's Labour's Lost" the proportion of unstopt to end-stopt lines is 1 in 18·1432 ±, while in "The Winter's Tale" this proportion has sunk to 1 in 2·1214 ± ("Bless thee, Bottom!"), and to learn the numbers and percentages of light-endings, of weak-endings, of verse lines, and so forth ("God bless us, a thing of naught!"), and to classify the plays into Life-Plea Plays, Unfit-Nature or Under-Burden-Failing Plays, Ingratitude and Cursing Plays, and Plays of Reconciliation and Forgiveness.† But "when all is done," this is not studying Shakespeare, any more than measuring star-places is studying astronomy, or counting the colours in a noble painting is studying art. Even the attempt to recognise from the style what Shakespeare really has or has not written, in works attributed to him, or what he has written when at his best or not so well, is of little real worth compared with the loving study of his grand creations. Loving, yet not unthoughtful. We would not see Shakespearean students accepting all that he has left us, as if it were beyond criticism. There is scarcely a play of his whose plot is without fault or blemish, and in many of the finest the borrowed story, which not only forms the groundwork of the plot, but is left to form the plot itself, is absurd, and sometimes even monstrous. Those who try, in their love for the poet, to defend or to praise what was no part of his work (though he was in fault for not rejecting it), in reality fail to understand him, and do his fame ill-service. Claudio's light-hearted acceptance of Hero's cousin, Bertram's sudden resolve to love Helena "ever, ever dearly," the Duke's "Your evil quits you well" to Angelo (murderer in intent), Valentine's "All that was mine in Sylvia I give thee," and hundreds of such flaws, belonged as certainly to the original story as Cæsar's *Et tu Brute!* If we take them as Shakespeare's we mar his work. Nor can any thoughtful reader fail to see in his earlier writings the signs of weakness and bad taste,—the weakness that of inexperience, the bad taste not his own, but that of his age and surroundings. It is only by separating these imperfections from his true and matured work that we can rightly and lovingly appreciate the greatest poet the world has known.

The edition before us is not injured by the petty talk of letter- and line-counters, date-hunters, and the like, for no

* "The Leopold Shakspere." Messrs. Cassell, Petter, & Galpin, London.

† If there is one thing more than another which could mark a man as thoroughly unable to recognise the true value of Shakespeare's gift to man, it is such an attempt to classify his many-sided plays.

one is obliged to touch their ill-arranged note-heaps. We doubt if any one could read through what they tell us. Dipped into occasionally, such matter is often interesting enough, and always amusing. It is unfortunate that Professor Delius's arrangement of the plays in conjectural chronological order should have been followed,—the first part thus becomes mainly occupied with inferior or doubtful plays. Our ideal Shakespeare edition should not contain "Titus Andronicus," whether Shakespeare wrote all, any, or none, of this hideous play. Part I. of "Henry VI." follows, and in all three parts of "Henry VI." there is much which is entirely unworthy of Shakespeare, as we know him in his greater historic plays.* "The Two Gentlemen of Verona" comes next, an immense relief, and then the "Comedy of Errors," which Dr. Dowden, forgetting the "Taming of a Shrew," calls Shakespeare's only Farce. This play, whatever artistic faults may be found with it, is one of Shakespeare's brighest, the style of fun being something like Molière's. It is interesting, as seeming to bear undoubted reference to Shakespeare's own life. Twins (Hamnet and Judith) had been born to him three or four years before,† and twins abound in the Comedy; but that is not the point. Probably about the time when he wrote the "Comedy of Errors," he being then some 25 and his wife 33, the natural effect of his unwise marriage six or seven years before had begun to be felt rather painfully by him. He had learned the lesson which he taught a year or two later :—

> Let still the woman take
> An elder than herself; so wears she to him,
> So sways she level to her husband's heart.

Also, it is to be feared, this other lesson, that,

> However we do praise ourselves,
> Our fancies are more giddy and infirm,
> More longing, wavering, sooner lost and worn,
> Than women's are.

(At least, when the woman is much the elder.)

> Then let thy love be younger than thyself,
> Or thy affections cannot hold the bent.

It is no unfair assumption to suppose that in Adriana, Shakespeare pictured the erst fair Ann Hathaway; in Antipholus of Ephesus himself. (It would be sacrilege to think thus of any characters in his later and greater plays). Possibly he may have meant the Abbess's rather severe teaching for his wife's special benefit :—

> His meat was sauced by thy upbraidings:
> Unquiet meals make ill digestions;
> His sports were hinder'd by thy brawls:
> Sweet recreation barr'd, what doth ensue
> But moody and dull melancholy,
> Kinsman to grim and comfortless despair? &c.

The other play in this first part is "Henry VI.," Part II., little better than Part I.

All illustrations to Shakespeare are "an abomination of desolation," from Sir John Gilbert's, Harvey's, and the like, down to those illustrating Dick's "Penny Shakespeare." Those in the present edition are among the worst we have seen. Before issuing an illustrated Shakespeare, publishers should wait till they can engage an artist as great in his own line as Shakespeare in his,—and *then* they should be assured that their artist understood Shakespeare.

* It is rather singular that in "Titus Andronicus" and the First Part of "Henry VI.," both of which contain passages utterly atrocious in style and treatment, insomuch that some question whether Shakespeare wrote a line of either, both contain lines so similar to some in his earlier sonnets as to leave little doubt that they came from the same pen. Thus, compare "Titus Andronicus," act ii., scene 2 :—

> "She is a woman, therefore may be woo'd;
> She is a woman, therefore may be won."

And "Henry VI.," Part I., act v., scene 3—

> "She 's beautiful, and therefore to be woo'd;
> She is a woman, therefore to be won."

With these lines in the forty-first sonnet :—

> "Beauteous thou art, therefore to be assail'd;
> Gentle thou art, and therefore to be won."

Perhaps, however, some ten-syllable proverbs familiar in Shakespeare's time may have been quoted, or referred to, in all these passages.

† Susannah was his first-born. Mr. Furnivall's account of Shakespeare's early love is rather exceptionally absurd. He is good enough to admit that if Shakespeare was a "young stupid," so also were most of us; and telling us that one day Anne and William "read no more," he kindly explains "that is Dante's," as if the loves of Francesca de Rimini and Paolo were not known to all.

## A NEW GUIDE TO THE ALPS.*

THE season of Continental travel has come, and guide-books are in request. Murray and Baedeker are dear, and they overlook sometimes the minor wants of travellers. They address their readers as though already experienced travellers. The guide before us is very cheap (half-a-crown cannot be called a large price for a book of more than 400 pages, with many elaborate maps and diagrams, and crowded with information on all sorts of topics important to travellers). If we do not altogether admit the scientific accuracy of the description "indispensable," which occupies a whole page at the beginning of the book, we must admit that a work such as this claims to be, is, at the price, a very desirable addition to the contents of the tourist's wallet. It treats of Switzerland and the Swiss, and Alpine animals and vegetation, gives hints to tourists, discusses the various routes of travel, and deals in special articles with hotels and *pensions*, mountaineering, what to wear, glaciers, Swiss butterflies and moths, avalanches, baths and springs, the Alps generally, the Upper Valais, the Bernese Oberland, the Italian Lakes, and many other subjects too numerous to mention.

Some omissions should be corrected in later editions. The carriage-roads over the Ober Alp should have been shown in the general map, while the railway under the Lukmanier should have been omitted. We note also the entire omission of the Gries Pass. Monte Generoso and the Rieder Alp afford good rest for the weary, not mentioned in the "J. E. M. Guide." Such omissions, however, though they might be noteworthy in an old-established Guide, may well be excused in a new one.

AMONGST the many electrical companies started during the past few days is one for working a material called insulite. It is intended to be used as an insulator, superseding glazed porcelain, ebonite, &c., and is composed of sawdust and suchlike substances, held together by ozokerit. In the prospectus, it is stated that the material has been supplied to the General Post Office and a number of electrical authorities. So far, however, as our information goes, the Post Office has only had a few specimens for trial. On subjecting the insulite to a moderate temperature, it expanded like so much dough, and crumbled to pieces between the fingers. It is, moreover, incapable of taking small screws. Under these circumstances, telegraph insulator manufacturers and ebonite merchants need fear little from this substance, which has been brought out with such a blaze of trumpets.

* "The Alps, and How to See them: the J. E. M. Guide to Switzerland." Edited by J. E. Muddock. (Simpkin, Marshall, & Co.; Wyman & Sons, London.)

## TRICYCLE RIDING FOR LADIES.*

THE opinions of society, at least English society, are changing, not slowly and surely, but quickly and surely, as to what women may or may not do.

This is observable more especially in the matter of sports. Hardly any athletic game is now brought forward but women can take part in it with men, if they please. And let me say this is a privilege and a benefit to both men and women, for nothing is more healthful to both than their joining together in their amusements. Men have a great respect for those, be they whom they may, who can play a good game with them. It produces a kindly, hearty feeling; and when called forth by women, brings with it the addition of a chivalric honesty. He really does wish to give her a "fair field," while she really does wish to receive "no favour." This was very pleasantly shown in a lawn tennis match which Major Wingfield (who introduced lawn tennis to the English public) and a lady, some little time ago. The lady proved such a formidable opponent, that he declared that he had the greatest difficulty in beating her, and that if she had not been unduly handicapped by the weight of her dress, the issue of the game would, no doubt, have been different. To test the truth of his conclusions, he begged that the lady might have her clothes weighed, while he would also have his weighed. His were found to weigh 4½ lb., while hers weighed 10 lb. This disproportion of weight to carry, as any one acquainted with "sport" well knows, is enough to make either man or horse lose a race.

In a similar way women allow themselves to be over-weighted throughout the whole of their lives, whether at work or at play.

In the matter of "play," tricycle riding affords another very striking example. Nothing in modern times which has been offered them can be reckoned a greater boon. Something to vary the dull uniformity of their lives—the daily monotonous walk, the perpetual sauntering along the same streets, gazing vacantly into the same shop windows.

The *Sanitary Record* for this month has a short article recommending tricycles to its readers. It says:—"Tricycles have over bicycles the great advantage that they are suited to every age, to both sexes, and the most varied physical conditions. Every one in ordinary health, and possessing the use of his limbs, can, without effort, and without previous instruction, learn to ride a tricycle. Very little practice enables the tricyclist to traverse considerable distances with ease, comfort, and safety, and at a very adequate and satisfactory pace. A pace of from seven to ten miles per hour is easily attained on the tricycle, and maintained for several hours in succession without effort. The exercise is distinctly healthful, and the mere rapid motion through the air is of itself invigorating and refreshing. Moreover, it is so much more pleasurable to many than the slower exercise of walking, and the facilities for covering an extent of ground and getting quickly out into the country, or the most pleasant suburbs of great cities, are so great, that we cannot too strongly recommend our readers generally to try for themselves the advantages of the tricycle."

But here, again, women's clothes are a hindrance and impediment—a constant and unnecessary tax upon their strength and endurance.

It is not in this case, as in lawn tennis, the *lifting* weight of them which tells, but the *resisting* weight. The *Sanitary Record* says, everyone "possessing the use of his limbs" can learn to ride a tricycle, but can a woman tied up in petticoats be said to possess the use of her limbs? Every time she lifts her legs to move the treadles they have to encounter, resist, and battle with the weight of the overhanging skirts, while in going against the wind they offer about four times as much resistance as the man's trousers, and every tricycle rider knows how that extra labour tells in working the machine. Moreover, the really unprotected, unclothed condition of the lower part of a woman's body requires that the greater part of her attention and efforts should be directed towards defending herself against ridiculous and indecent exposure.

Women naturally sensitive on these points hold aloof from attempting tricycle riding on this account, and will continue to do so till a more suitable and safe garment is provided for them. A lady who is now a member of our Rational Dress Society wrote to me from Scotland, asking for a pattern of our divided skirt. She said that ladies in her part of the country had to drive about a good deal in dog-carts, that she had often longed for some sort of dress like the one we had introduced, because getting up and down in these vehicles was "something too dreadfully awful."

It is this fear of making a "too dreadfully awful" exhibition of herself which deters many a woman from tricycle riding, so that it is mostly confined to those who can indulge in it in the privacy of their own grounds. But these are the women who least require the exercise—they usually have carriages and horses, for riding or driving anywhere they please—or they can transport themselves to "foreign parts" whenever so inclined. With women of this class, too, any amusement, however good and healthy, is but the fashion of the hour—to be indulged in for one season, and forsaken the next. But if tricycle makers wish to secure a large and constant sale of their machines, they must make them popular with that much larger class of women whose only mode of quick locomotion would be a tricycle; and when they had once experienced its pleasure and health-giving power, they would not lightly relinquish the use of it.

Those who are interested in seeing lady tricycle riders the rule instead of the exception, as at present, should turn their attention to inducing them to adopt a dress suitable to it—namely, one that clothes them properly and decently, and one that does not, by unduly handicapping them, overtask their strength and energy.

I shall be only too pleased to assist any of the lady members of the B.T.C. with suggestions, as well as to aid them in forming a Ladies' Committee at any time.—Mrs. E. M. KING, Hon. Sec., Rational Dress Society, 34, Cornwall-road, Bayswater, London.

* From the *Monthly Gazette* of the Bicycle Touring Club for May, 1882.

## BUTTERFLIES AND MOTHS.

BY W. J. H. CLARK.

THERE is one branch of entomology which we are sorry to say has not received the amount of attention that its importance deserves; we refer to breeding from the egg. The method of accumulating a good collection is far more satisfactory and profitable than either catching the *imago* or breeding from the *larva*.

It is true that egg-hunting presents many difficulties to the beginner, owing to the extreme minuteness, in some cases, of the egg, but these will be got over with a little time and practice.

It is an undisputed fact that a very large percentage of the eggs laid annually by butterflies and moths do not develope into the perfect insect, the reason for which must be looked for in the ravages of birds, and other causes which destroy the caterpillar soon after its exit from the ova, and also in ichneumon flies, which kill the insect when in the pupal state.

When bred up in the house, all these destructive influences are done away with, and a large number of the eggs will hatch out, and finally become perfect insects.

When hunting for eggs, a few shallow boxes made of thin wood or card-board should be taken, in which the eggs can be carried home.

A very careful search among the leaves (especially the under sides) and twigs of trees, stalks, and leaves of grasses, fences, and numberless other places will probably yield good results, and the leaf or twig should be cut off and placed in one of the before-mentioned boxes, as by this means they will not become broken by touching one another.

If the eggs are attached to a wooden fence or railing, the piece on which they are deposited must, if possible, be carefully cut away with them, as scraping or brushing off must *never* be attempted, owing to the exceedingly fragile nature of the external covering membrane.

Also take notice what trees are in the immediate vicinity, as one of them will in all probability form the food of the future caterpillar.

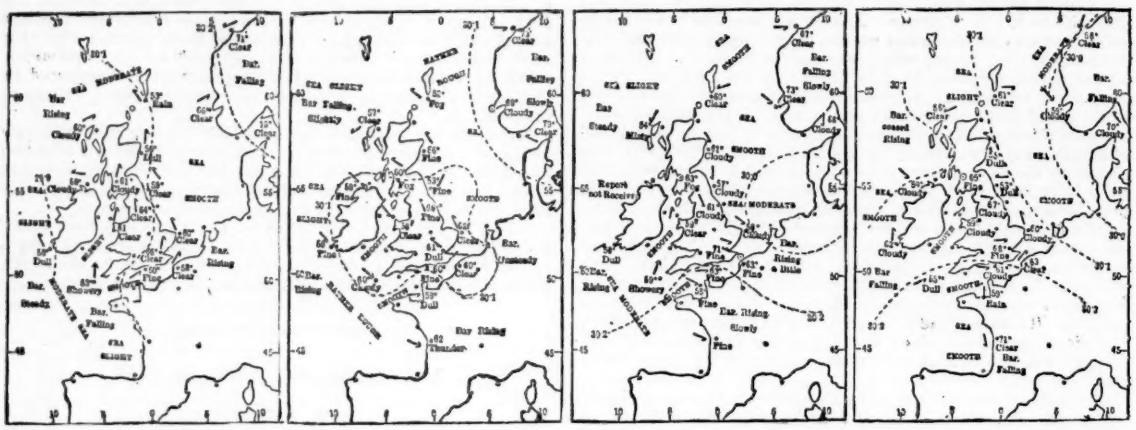
When the eggs are taken home, place them in a shallow box without a lid, carefully noting down particulars about each batch of eggs—such as time of year and where found, whether laid singly or in clusters, and any other circumstance connected with them—as these notes form a very useful reference for future years.

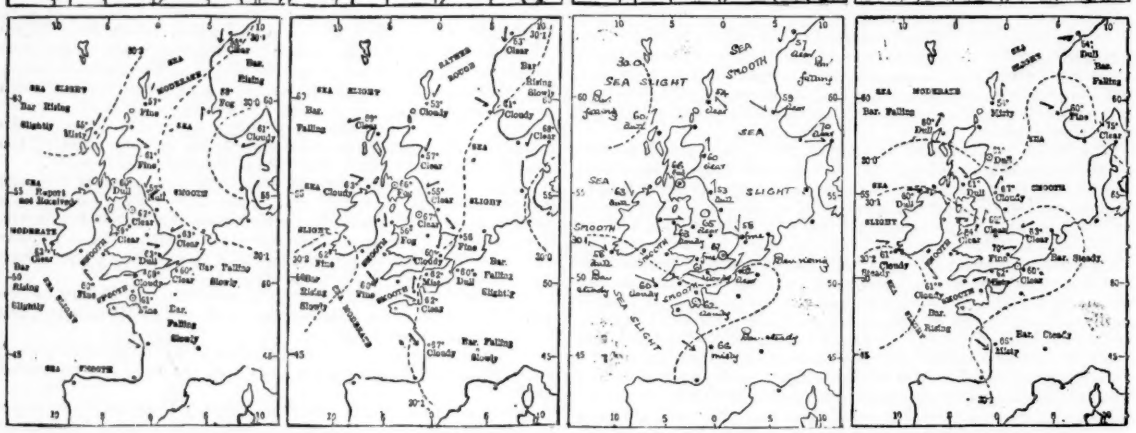
FIVE DAYS' RIDE ON A TRICYCLE.—First day. Hornsey, *vid* Hendon, Acton, Hounslow, and Basingstoke to Andover, 73¾ miles. Second day. Andover to Stonehenge, Salisbury, and Whiteparish to Romsey, 43 miles—very hilly, and strong head wind. Third day. Romsey to Botley, Wickham, Southwick, over Portsdown Hill, Havant, Chichester, and Arundel, 50¾ miles—hilly to Havant, and strong head wind all the day. Fourth day. Arundel to Worthing (morning); in the evening Worthing to Horsham, 30½ miles. Fifth day. Horsham, Crawley, Reigate, Croydon, Streatham, Brixton, Westminster Bridge, Thames Embankment to Holborn Viaduct, 40¼ miles. Average, 47 odd miles a day; luggage carried, over two stone. Lovely weather, ditto scenery, and most enjoyable fatigueless ride.—EX-BICYCLIST.

XUM

## WEATHER CHARTS FOR WEEK ENDING SUNDAY, JULY 2.

SUNDAY, 25TH. MONDAY, 26TH. TUESDAY, 27TH. WEDNESDAY, 28TH.





THURSDAY, 29TH. FRIDAY, 30TH. SATURDAY, 1ST. SUNDAY, 2ND.

In the above charts the dotted lines are "isobars," or lines of equal barometrical pressure, the values which they indicate being given in figures at the end, thus—30·4. The shade temperature is given in figures for several places on the coast, and the weather is recorded in words. The arrows fly with the wind, the force of which is shown by the number of barbs and feathers, thus:— ⟶ light; ⟶, fresh or strong; ⟶, a gale; ⟶, a violent gale; ⊙ signifies calm. The state of the sea is noted in capital letters. The * denotes the various stations. The hour for which each chart is drawn is 6 p.m.

## FORESTS AND RAILROADS.

FROM an official report made on American railroads, we have some curious facts relating to the direct connection between the railroads and the deforestation of the United States. From it we learn that it takes 200,000 acres of forests to supply cross ties for the railroads of the United States every year. It takes 15,000,000 ties to supply the demand on these railroads, for which on an average the contractors get 35 cents apiece, making in the aggregate 5,250,000 dols. In building a new road the contractors figure on 2,700 ties to the mile, while it takes 300 ties to the mile to keep a constructed road in repair. Contractors, of course, buy pieces of timber land as near to the proposed line of road as possible, paying for the timber an average of about 20 dols. per acre, or giving the proprietor of the land 10 cents for every tie got out. The average of a good piece of timber land is 200 ties to the acre and 12 ties to the tree. The size of a cross tie differs on different roads, but the usual size demanded is 8 ft. 6 in. long and 8 in. face. White or burr oak is considered the best timber for the purpose, although cherry, maple, ash, and even locust have been used. The last named were first used on the little Miami railroad, and after a time thrown aside as unfit for the purpose. Railroad men much prefer ties hewn out with an axe to those sawn in a mill, and many contend that the first-named will considerably outlast the sawed ties. This theory is probably a fallacy, as sawed ties have been placed alongside of hewn ties and remained sound twice as long. This business gives employment to an army of choppers, who are paid 10 cents apiece for each tie. Continued practice makes the choppers expert in the use of the axe, and a single man has been known to get out thirty-five in a day; yet the average is only ten while an expert will probably get out twenty. During the war, when ties sold at from 60 to 65 cents, choppers were paid 12½ cents apiece. Although the contractor gets 35 cents apiece from the railroads for each tie, still there is a loss of from 5 to 7 per cent. on dockage and stealage. An inspector is sent by the company to inspect the ties. This is generally a clerk from some of the offices, who frequently knows but little as regards the strength and durability of timber, and as a consequence some of the best trees are docked and only bring 20 cents apiece. The stealage is where the sectionmen put in new ties which have not been inspected and received, and fail to report the use of the same to the roadmaster. Nearly all cross-tiemen also contract for the bridge timbers and trestling, as well as for telegraph poles. For the latter, chestnut and cedar are generally used. They bring about 1·75 dols. apiece, and are cut mostly in the Tamarac swamps of Michigan and the forests of Southern Kentucky and Tennessee.—HENRY F. MOORE, in the *Journal of Forestry*.

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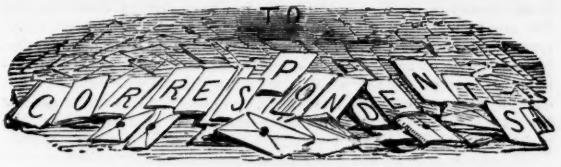


# Letters to the Editor.

*[The Editor does not hold himself responsible for the opinions of his correspondents. He cannot undertake to return manuscripts or to correspond with their writers. All communications should be as short as possible, consistently with full and clear statements of the writer's meaning.]*

*All Editorial communications should be addressed to the Editor of* KNOWLEDGE; *all Business communications to the Publishers, at the Office, 74, Great Queen-street, W.C.*

*All Remittances, Cheques, and Post-Office Orders should be made payable to Messrs. Wyman & Sons.*

**** All letters to the Editor will be Numbered. For convenience of reference, correspondents, when referring to any letter, will oblige by mentioning its number and the page on which it appears.*

**"In knowledge, that man only is to be contemned and despised who is not in a state of transition. . . . . Nor is there anything more adverse to accuracy than fixity of opinion."—*Faraday.***

**"Show me a man who makes no mistakes, and I will show you a man who has done nothing."—*Liebig.***

## THOUGHT-READING.

[454]—The account in last week's KNOWLEDGE of the feats performed by a conjuror before the late Charles Dickens has reminded me of similar feats of which I was a witness at Athens in 1875. A French conjuror, whose name, I think, was Caseneuve, gave me a piece of paper, folded up, and asked me to hold it. He then gave to one of the audience a bag of lotto numbers, to another a Jack of cards, to a third a bag of ivory letters, to a fourth a ball of string and a pair of scissors, and to a fifth, a friend of mine sitting next to me, a box of dominoes. At the conjuror's request the first selected a number, the second a card, the third a letter, the fourth cut at random a piece from the ball of string, and my friend chose a domino. When the first had chosen his number, he, at the conjuror's request, passed the bag to his neighbour, and so with the others. The conjuror then asked me to open the paper and to stand up and read aloud the contents, which were in French. This I did. They consisted of sentences such as the following:—The card chosen will be the Knave of Clubs; the length of the string cut will be 1 mètre 15 centimètres, and so on. In each case the prophecy was correct.

As before stated, the domino was chosen by my friend. I carefully examined the box and found it to contain a complete set of dominoes. HENRY M.

[There is a well-written note by Professor Donkin in this month's *Nineteenth Century*, endeavouring to show that the evidence given by Professor Barrett and two colleagues proves very little. Without at all accepting the Brain Wave Theory, I must confess that I have been led by several remarkable experiences, to the conclusion that mind can rule mind in some way,—physically interpretable, no doubt, but not as yet explained.—ED.]

## THE "COLD SNAP" IN JUNE.

[455]—I have read a good deal in KNOWLEDGE about the cold week in May, and have seen M. de Fonville's asteroidal theory exploded most thoroughly, and, as I think that the abnormal temperature of 10th—12th June was as much or more marked than the three days of May, I beg to suggest that the cause of the same may be found in the enormous diameter of the cyclone, and the slow movement of its centre, which encompassed us, and the position in it, in which we were placed at that period. It must have been at least 2,000 miles in diameter.

If upon your weather chart we trace back the isobar curve, which is nearly always coincident with the direction of the wind, to the distance of the quadrant of a circle, we shall find that the air which we received must have been, only two or three days before, driving over immense tracts of ice-bound mountainous country, even beyond the arctic circle in Norway and Russia, and no doubt driving herds of icebergs into the Atlantic.

We know that air is not warmed directly by the sun, but by contact with, and radiation from, a warm surface—generally land; that air cannot be warmed appreciably above 32° where snow exists, and that only a small rise of temperature can take place in passage over water; therefore, in this position, we receive the cold blasts at a temperature very little above what they left these wintry regions at.

I think in this also may be found the disagreeableness of the N.E. wind—the cold air travelling over our warmer lands has its point of saturation so suddenly raised, that it wrings the moisture out of everything, fairly burns up vegetation, and produces that unpleasant feeling in the skin (really a dryness) so well known during these winds. It may be advanced against this that it very often rains from the N.E. I should say that on such occasions it must have started from the far north raining much heavier, and is decreasing all the way south. At such times, owing to the moisture present, the objectionable feeling of the skin is not apparent.

If this theory be correct, we should always experience such weather upon the back of a large, well-developed cyclone, or upon the front of an anticyclone, when the centre, travelling slowly from W. to E., passes to the north of us. J. MORRIN.

## CONSUMPTION.

[456]—Allow me to offer a few hints which do not agree with Koch's germ origin of phthisis. There are a few well-known kinds of consumption, known as the knife- or scissor-grinders', the miners' or marble-masons', and the cotton-sorters'. In all these cases the disease is due to breathing small particles of iron, coal, stone, or cotton. These particles are carried into minute tubules of the lungs, and there set up irritation and inflammation by their presence. The sputa of these patients contain iron, coal, or stone particles. There is also another kind of consumption which does not come under Koch's theory, and that is fibroid consumption, due to excessive drinking of alcoholic liquids. Consumption is caused by anything which tends to weaken the body, amongst which impure air may be set down as a great cause.

Many of the present generation are carrying the germ theory to excess. Many medical men are afraid of germs as if they were poison, and will not allow a simple wound to heal without applying some germicide. The healthy body is the best known antidote to germs; a germ cannot flourish there; it is like throwing seed on a rock—it soon perishes. [But if the body is unfortunately not healthy?—ED.]—Yours truly,

*June* 24, 1882. T. R. ALLINSON, L.R.C.P., &c.

## BREAK FOR TWO-WHEELED VEHICLE.

[457]—Malvern town abounds in steep hills. The two-wheeled vehicles, from the doctor's gig to the butchers' and bakers' carts, have double breaks, *i.e.*, one to each wheel, actuated by a lever similar in construction to that used on four-wheeled vehicles, applied to the back of the wheels, in a line level with the axle. R. G.

*May* 29, 1882.

## FIELD EMETICS.

[458]—"As a practical thing to know (in the field), a charge of gunpowder is a capital emetic—*try it (in corpore vili)*."—(*Vide* KNOWLEDGE, vol. ii., p. 8.). [Query—Would not dolomite, shaken up with water (it would not dissolve), often be of value, on account of the carbonate of magnesia? M.

## TRICYCLING.

[459]—Probably, many of your readers may be seriously thinking of procuring a tricycle, and securing exercise and change of scene by that most excellent and delightful means.

To such as may be that way inclined, a few words of advice as to adjustments, accessories, &c., from a practised cyclist may, perhaps, be useful.

I mentioned in my last letter the machine and size of wheels I have found to give me the most satisfaction, and will merely now say that, whatever may be the machine selected, *it should drive both wheels direct*, without any complications, but with simple chains with revolving ferules on the links. These will be found to be much more reliable than anything else, in spite of objections in theory that may be urged to the contrary. I have ridden my machine some 4,000 measured miles since last June, and never yet had any trouble whatever with the chains. My advice is, specially avoid all complicated mechanism, as it is sure to go wrong before long when put to the incessant jarring of the roads, or to make an irritating, rattling noise.

With a large wheel, a weak rider can secure great ease of working by "gearing down," *i.e.*, by having his top cog-wheels with more cogs than the bottom ones, which gives increased power up hills, though, if carried to excess, it much decreases the speed.

All who wear trousers should ride upon saddles—not seats. A saddle allows the legs to hang freely downwards, and to work without

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restraint from the hip. And though in the shop it may seem that a "seat" is much easier when used as one might use an ordinary chair, and sat "squab" upon, when riding this cannot be done, and at the same time permit the legs to move from the hips (as in walking), which is a *sine quâ non* for comfort in riding. A man on a seat must have his legs bent at an acute angle at the knees, and he then presents a very unsightly appearance, with his knees popping up and down almost up to his chin, besides the extra fatigue involved. Saddles are made with a broad seat, and also with backs, and they are really most comfortable, and the pommel so divides the fork as to avoid all chafing. EX-BICYCLIST.

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[460]—It may interest those of your readers who are tricyclists to learn that Mr. Marriott, of Nottingham, has ridden from Derby to Holyhead, through Burton, Lichfield, Shifnal, Shrewsbury, Corwen, Bettws-y-Coed, and Bangor, a distance of one hundred and eighty miles, in twenty-three hours and three quarters on a tricycle. The road for quite half the distance was mountainous, some of the hills being six and seven miles long, and in many parts the roads were so rough that it was like riding through the bed of a stream dried up. For a tricyclist, this is the longest journey in twenty-four hours on record. JOHN BROWNING, L.T.C.

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## INFLUENCE OF CLIMATE ON PLANTS.

[461]—In a number of KNOWLEDGE on which I cannot at present lay my hand, I noticed some facts with regard to the influence of climate on plants. It may interest your readers to know that plants feel severely the change in their usual habits which takes place when they are transplanted from Europe to South Africa. The Curator of the Botanical Gardens here, who has, perhaps, more practical knowledge of tree-planting than any man in the country, informs me that this is markedly the case with regard to fruit-trees. The reversal of the seasons, occasioned by the change of hemisphere, bewilders the plants, which are in some sense "educated" to such a degree that they are not able to survive the shock. The only chance of getting them to grow is by grafting, when they borrow the constitution of the tree on which they are grafted, and acclimatise readily. Ordinary deciduous trees behave very irregularly also. Sometimes they will pull through, sometimes they die, but the first cuttings never appear to thrive. I understand that evergreens are not affected.

Birds take to the change of season well, if one may judge by the few European sparrows which have been introduced. European dogs generally die. Imported oxen and horses appear to do well, provided they receive the same amount of care which they experience at home. Cats thrive.

Perhaps I may be pardoned if I suggest that the appearance of numerous articles from upholders of Darwinism in your capital magazine, must not lead your less scientific readers to imply that Darwinism is by any means universally accepted. It is, admittedly, only a hypothesis. I use the word hypothesis in the sense to which you restrict it in "Pleasant Ways in Science" (p. 315), as an opinion not based on phenomena. Dr. Mivart, one of the greatest of living anatomists, terms it, with all due solemnity, "a puerile hypothesis." May I be allowed to recommend to those of your readers, who are not terrified by mere weight of names on the other side to read carefully Mivart on the "Genesis of Spenies," Dr. Elam's "Winds of Doctrine," and Dr. Beale's "Protoplasm," in which they will find refreshing antidotes to the works of Darwin, Huxley, and Haeckel, the positive, comparative, and superlative exponents respectively of the fashionable doctrines in trancendental doctrine. Especially let them study well the history of "Bathybius Haeckelii," two unfit evolutions from the original Darwinic idea, which have ceased to survive.

As a last suggestion (I hope you will forgive the space) may I remark that your magazine is extensively read this side the equator, and that some good maps of the southern sky would be appreciated both here and in Australasia. J. NIXON.

Grahamstown, Cape Colony, *May* 4, 1882.

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## THE SPAWN OF "DORIS TUBERCULATA" (CUV.).

[462]—I have lately obtained a large mass of the riband spawn of the large Nudibranchiate Mollusc, *Doris tuberculata*, which, I think, worth mentioning in your columns. While on a visit last week with a relative at West Kirby, near Hoylake, Cheshire, I availed myself of the opportunity which a tide of about 18 ft. afforded, of a visit to the Hilbre island, at the mouth of the Dee. Having on a previous occasion been fortunate enough to secure several fine specimens of the beautiful *Dendronotus arborescens*, I thought I would try my luck again. I may mention that Hilbre island during the tides of the spring and autumn equinoxes is well worth visiting for specimens of marine zoology. The tides of last week, however, were not sufficiently low to expose at their full ebb the most promising places. At one spot I espied a large white mass of something hanging from a rock, and this I found to be the riband spawn of *Doris tuberculata*; it was hanging from the underledge of a rock of red sandstone, to which it was firmly fixed, except at one end of the mass, where, for about three or four inches, it hung loosely from the rest. On detaching the mass and unfolding it, I was astonished at its great length. I did not measure it, but I am sure that it was more than a mile long, and being in one uniform, uninterrupted band, it must have been the product of a single parent. The breadth of the band I afterwards found to measure one inch and four-tenths. Not far from this spot, a Hoylake fisherman, who was after prawns, scooped out in his net from under the ledges of the rock two creatures, which he politely gave to me; these were two fine specimens of the Nudibranch itself. The largest, which was of a beautiful lemon colour, without a single spot of any other colour, measures—for I have both specimens alive now—four inches in length and two-and-a-half in breadth. The other is not so large, and is handsomely marbled with yellow, dark brown, and delicate pink. I do not know whether this spawn-mass is of unusual size, but Alder and Hancock speak of an unfolded coil of *Doris* spawn of nine inches in length and nearly one inch broad as being one of large size. Specimens of *Doris tuberculata* have been found measuring five inches in length; I should think that the parent of the mass I found must have been larger; for the riband must have been fully forty inches long. This band, which is transparent, and fairly tough, is full of countless numbers of ova or embryos. I have kept a portion of this spawn in salt water nearly a week; on examining it under the microscope to-day, I find many of the embryos still alive and considerably developed. Very curious it is to witness the constant activity of these baby-nudibranchs, as they perform their rapid rotations within the enclosing transparent membranes. In some of these only one embryo is seen, in many, two are found; and not unfrequently, three are seen to disport themselves in one membrane or *chorion*. Conspicuous are the two oval lobes, which are thickly fringed with long, strong cilia, by means of which the little creature rows itself rapidly within its circumscribed "oval," and which are destined to play the same locomotive function when it is liberated from its chorion. Now these cilia are in motion, now they stop their machinery, and the little creature partially withdraws itself into an exceedingly thin, transparent shell, somewhat resembling that of the nautilus. The pedal process (foot) is apparent, and careful focussing reveals the presence of a delicate, transparent operculum on the under side of the foot. I see clearly the two circular otoliths in the region of the mouth; the stomach intestine and other viscera are evident enough, in a mass, but not easy to distinguish separately, owing to its opacity. The muscle which attaches the embryo to the bottom of the shell is seen in the shape of a semi-transparent conical organ. Nearly the whole of the rest of the body of the embryo is separated from the shell by a well-defined clear space. The figures in Alder and Hancock's Monograph (Fam. I. pl. 3) are well shown, and what is before me convinces me of their accuracy. Of the thousands of thousands of ova contained in the spawn of the nudibranchs, how few are destined to survive and reward the marine zoologists by their presence as adult animals. I am reminded of what occurs in oysters. Delicate locomotive larvæ, when free swimmers, are at the mercy of the rough waves, and in the troubled sea of their infancy they have but little chance of settling down to a quiet life, and developing the characters which mark the respective adult species; so that, I should suppose, the nudibranch babies require similar conditions to those necessary for the development of the young celiated oysters, *viz.*, a calm sea and a warm temperature. I secured one more nudibranch during my short visit at Hilbre, a fine *Eolis papillosa*. But, beautiful in colour and curious often in form as our nudibranchs are, it must be confessed that they are, as adults, dreadfully sluggish in their movements—painfully slow. This, I think, is especially true of *Doris tuberculata*. "Do move on, sir," one repeats in vain. I call them "Cretans." Would you know why? Because they are "slow bellies." Even as Epimenides calls the people of that island, in a line quoted by St. Paul (Titus i., 12):—

Κρῆτες ἀεὶ ψεῦσται, κακὰ θηρία, γαστέρες ἀργαί.

Of course it is only the latter description that is applicable to nudibranchs. W. HOUGHTON.

*May* 22, 1882.

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COAL UNDER LONDON.—At the half-yearly meeting of the proprietors of the Southwark and Vauxhall Water Company, it was mentioned incidentally that in sinking a new well at Streatham, pieces of coal had been found 150 feet below the surface.—*Daily News.*

## Answers to Correspondents.

**** *All communications for the Editor requiring early attention should reach the Office on or before the Saturday preceding the current issue of* KNOWLEDGE, *the increasing circulation of which compels us to go to press early in the week.*

HINTS TO CORRESPONDENTS.—1. *No questions asking for scientific information can be answered through the post.* 2. *Letters sent to the Editor for correspondents cannot be forwarded; nor can the names or addresses of correspondents be given in answer to private inquiries.* 3. *Correspondents should write on one side only of the paper, and put drawings on a separate leaf.* 4. *Each letter should have a title, and in replying to a letter, reference should be made to its number, the page on which it appears, and its title.*

M. E. H. H. Your answer to "Pyramus" is not correct. How do you make out fourteen for third year? There would be twelve for first year, each of whom at end of year would pay £40, making, with £6,000 annual subscription, £6,480; out of which, twelve more would each receive £500. At the end of second year there would be £6,960 for distribution, and thirteen (not fourteen) more subscribers would receive, each, £500, and so on.—H. J. MADGE. As stated, we were referring to the idea as presented by our correspondent. Permit us to say that your way of putting the theory is entirely unscientific—the "evolution of immense volumes of electrical energy which, flying off from the sun's body into space," &c., do such and such things, will really not do in the way of scientific description, even if the ideas underlying your account were sound. The theory that the greater eccentricity of cometic orbits is due to the cometic nucleus being "constituted of a nature less amenable to electric absorption than the planets," is utterly untenable.—F. SELLAR. Thanks; will consider both points.—ERIN-GO-BRAGH. Centre of earth generally regarded as solid. We are approaching Hercules, rate not known. Estimate usually given (150 million miles per annum) quite untrustworthy.—F. WINGFIELD. The question, p. 44, should have been, When will Arcturus cross the meridian three hours before noon? The mistake is tolerably obvious, for if sidereal time on December 9 at noon is 17 h. 10 m., it will not be 14 h. 10 m. at 3 P.M., but 20 h. 10 m.—J. CLARK wishes to know where in the writings of Augustine the saying occurs: "God is great in great things, but greatest in small things" (very kind of Augustine thus carefully to apportion his praise).—ONE OFFENDED. Your complaint is preposterous. We cannot ask advertisers to certify that the goods they offer at specific prices are worth the money. "Yea, indeed," as you put it, that would be absurd.—F. G. A. A bicycle in not kept in the vertical position in the same way as a hoop. In the case of a rolling hoop there cannot be displacement from the vertical without greater changes in the direction of motion of particles of the hoop than the hoop's weight can produce. But in the case of a bicycle, even when at high speed, the weight of the rider would suffice to bring the instrument and himself over, did he not combine with balancing movements such slight changes of direction as cause the weight which had been tending to produce sway in one direction to act in the opposite. The greater the rider's practice, the less these changes, till they are practically evanescent. But no bicyclist could trust to the steadiness resulting from the mere running of the wheels.—J. A. L. R. I doubt whether any photographs of the recent solar eclipse will be available for the "public eye" for many months to come. Very little of importance was added to our knowledge of the sun on that occasion. All that about evidence of the dissociation of the so-called elements in the sun is sheer windy nonsense. Professors Liveing and Dewar have disproved the supposed terrestrial evidence, and Professor Young the supposed solar evidence, and nothing new was obtained on that point, last May.—PHARMACEUTICAL CHEMIST. Fear it is only too true that bicycling injures the spine, though strongly-built men may not notice the effect for a long time. Theoretically, nothing could be much more mischievous to the system than jarring the body when in the attitude necessary for bicycling.—H. W. MALET. The late Sir Charles Lyell, on the contrary, attached great weight to Mr. Croll's geological investigations. The subject is, however, as you say, very difficult. I cannot quite see why the mere fact that the undated carboniferous system has buried the 3¼ miles of denuded matter, justifies your considering the work of denudation to have been done under water, and so multiplying the time by 1,740! Again, the geographical, and not the physiographical (horrible word), is the true surface measure in such cases; for the average denudation per square mile is in question, not the average measured vertically to the surface, with all its varying slopes.—A READER OF KNOWLEDGE. The comet may possibly be visible in the positions indicated elsewhere; but only with a good telescope.—CAMPSIE. Fear the transference of engravings to porcelain rather outside our range, but if any readers of KNOWLEDGE know how such work is done, we will find space for their account, if not too long.—AUGUSTUS J. HARVEY. Ah, yes! get Government to do anything, and it is sure to be done well,—Government not being carried on by men like the rest, but by men officially etherialised. Your "one hundred national painters," all painting "for the glory of England," would be sure to raise the tone of art. Our school boards ought to adopt this as a copy-book text,—*Official Position Ensures Continuous Assiduity.*—W. W. I would like to tell you at what point of the celestial compass our globe is at the summer solstice; but—forgive my ignorance—what *is* the celestial compass?—J. A. W. OLIVER. Thanks for your valuable and suggestive letter.—CARL S. The reverend gentlemen you quote and name imagine that because *they* can only conceive a deity very limited in his attributes (though they *talk* of Infinite Power, Omniscience, Omnipresence, and Eternity), science, which smiles at their limited deity, is atheistic. They are quite honest, however, in their denunciations. They have gravely told me of a scientific club—president, Professor Tyndall—founded for the advancement of atheism. The object, no doubt, is to get rid of all restraints, religious or moral. It is, of course, well known that nine-tenths of all the offenders brought annually to judgment in civilised communities are men of science (under disguised names).—A. AITKEN. Sorry for the mistake about postage; but the wrapper should have been sent to publishers, not to editor. I do not think your solution of Pyramus's question quite right, unless we assume that, as fast as money comes in, it is used to give subscribers their £500, or *such part of it* as can be distributed, those who have received a part paying a proportional part only of the annual £40. In that case, of course, your solution would be correct. Every one seems to understand the question differently, by-the-way.—G. L. HARRAP. If I remember rightly, there is a good exposition of the Nebular Hypothesis in Prof. Newcomb's "Popular Astronomy."—H. A. B. (1) Arago's delightful Essay on Lightning (in his "Meteorological Essays"). (2) The fact that after June 21 the days do not shorten as rapidly as they lengthen after December 21 is due to the motion of the earth being slower in June and July than in December and January. The earth, as it were, hangs longer in the solstitial neighbourhood. (3) The sun's orbit in stellar space is not circuited in hundreds of thousands of years; thousands of millions would be nearer the mark, I imagine. (4) The instinct and reason differences hard to define.—R. S. MCKERRELL. Go through the work to be indexed, writing down the title and page of each subject on a separate small slip of paper, or, if of sufficient importance, on two or more, varying the heading, as,—Spots on the Sun, by W. Huggins, p. 113; Sun, Spots on, W. Huggins, p. 113; Huggins, W., Spots on the Sun, p. 113. Then sort; first into letters, then under each letter into proper alphabetical position.—W. LEES. We have such a list; but we are not free to lend it; so far as we are concerned, we would willingly do so. We do not belong to the society.—SERGEANT A. SHARPE. Many thanks; but electrical and telegraphic articles already provided for.—FACIEBAT. That leaf (v., vi., in No. 33), is not to be bound with the volume. The advertisement par. at foot of p. 47, was inserted by mistake of printers, as you can gather by glancing over advertisement columns. The contributor you name has promised to do what those you refer to would not do, and his papers will have an independent value accordingly, and be practically more useful; just as my valued friend F.R.A.S. describes nothing in his "Nights" which he has not examined at the telescope within a few hours of the time of writing.—J. H. COBBETT. Four weeks of ill-health (we are quite well again, thanks) must be our excuse for not sooner replying. Like you, we have never seen either Venus or Eve, in painting or statue, represented otherwise than as a more or less beautiful young woman, born in the usual way. Michael Angelo, who represented Moses with horns, might have ventured on a bolder course with either of those ladies, or with both. Many thanks for your kind advocacy.—J. L. H. Thanks for solutions of mathematical problems. We give shorter and more general solution.—J. GREY. Doubtless the comet: see part of reply above to J. H. Cobbett.—EXCELSIOR. See reply to J. H. Cobbett.—A JUNIOR. It should hardly be necessary to say that I personally would prefer having more astronomy; but I yield place to others, and ask others to do part, or most of the astronomy.—J. A. H. The difficulty has been that description of the microphone turned out to be very long and illustration rather expensive. We cannot keep our correspondents' promises.—P. H. D. The ice theory has difficulties; but if every year there is a cold spell due to ice, and the average time for this is a particular part of May, that would account for the observed fact—the three cold days.—C. M. POOLE. Yes; there is room for all. The point is that with natural increase, even as now checked in England, a few hundred years would overcrowd the earth, counting "humans" only.—J. K. Yes; Browning's Rainband Spectroscope shows the rain-sign admirably.—VERBUM SAP. Yes; but how about the proprietors, if we thus do adver-

XUM

tising gratis?—J. W. BLOOM, ED. We shall be only too glad to notice the magazine; as we write, your letter only to hand from head office.—ARAB. Alas! we have never played Napoleon, and your question is an enigma to us.—H. SADLER. We agree with you, and so, we fancy, would our friend, F.R.A.S., on further consideration, that the common proper motion of Castor and * implies that they *are* connected.—T. J. HICKIN. Thanks. (1) It would be a pity were a chance given for "the enemy to blaspheme." Dr. Ball went rather beyond the record in saying that if all the planets did not revolve in the same direction, the solar system would have perished long ago." Perhaps I went also beyond the record in saying "it would have been as well with the solar system as at present if some planets went one way and some another." Laplace proved that with all the planets going the same way round, and all with small inclinations and eccentricities, there could be no destructive changes in the solar system. *But*, he never proved that if any even of the large planets went the wrong way round, there *would* be destructive changes. Dr. Ball, by saying, "at all events, the larger planets," shows that he recognises the quantitative character of the problem, with which analysis has never dealt in a quantitative manner. I am satisfied the revolution of Jupiter the wrong way round would do no more harm than that of the earth or Venus—perhaps less, when due account is taken of the much greater scale of the distances in the system of giant planets than in that of the terrestrial planets. Albeit, this has never been proved. From the nature of Lagrange's equations in dealing with this matter, it may be regarded as shown that the stability of the solar system would not be absolutely certain, as now (without much more inquiry) if any of the planets went the wrong way round. (2) Any text book of geography which states that the variation of the major axis of the earth's orbit has influenced climatic relations, has undoubtedly blundered. It should be "minor axis," though the major axis is very slightly variable, in long periods of time, in an oscillatory manner. You quote Mitchell's "Orbs of Heaven," but he was not competent to give an independent opinion on such matters. We find him confounding the parallelogram of velocities with the parallelogram of forces, and making other mistakes equally fatal to his position as an authority.—W. PARKER. It is not easy to say what books would suit you, as the range from the easiest to the most difficult is so great. East and west are different in star maps and geographical maps, because we look up to the skies and down upon the earth. Note, however, that in my maps there is no right, or left, or top, or bottom; but the middle is the top, and the bottom is all round.—E. T. C. W. Might you not as well argue that since the moon affects the tides, so may Saturn or Jupiter affect the ocean in some other, but quite as marked, manner? The influence of the moon on lunatics, assuming it to exist, might depend in some way on her attractive, luminous, thermal, or magnetic influence; compare any or all of these with any corresponding influence which any one of the planets could exert, and you will see that astrology (which assigned much *more* potent influences to Jupiter and Saturn than to the moon) cannot possibly derive support, as you suggest, from lunar influences.—R. WOOD. I referred to pure chance tossing, not to the skilful repetition of precisely identical tossings; but I said suspicion would be justified. There are two theories—one that the coin has two heads, the other that it is a fair coin—on the first the chance of the observed event is 1, on the other it is about 1-millionth. Hence, the probability of the first theory comes out, by the formula we gave, very much greater than that of the second (supposing both *antecedently* to be equally likely); or it is most probable, though not quite certain, that a two-headed coin is being used. If there were any feasible way of explaining as simply the occurrence of twenty tossings always as predicted, though not always of one kind, precisely the same reasoning would apply to a case where each of twenty tossings was in favour of the tosser. Suppose, for instance, the theory to be that he has one two-headed and one two-tailed coin, and that he is so dexterous that, while seeming always to toss one coin, he in reality changes them at will; then if he wins twenty times in succession, the chance of that theory being true would be much more likely than the chance that one coin is used,—even though the odds against his being so skilful and also so dishonest, were, antecedently, a hundred or a thousand to one.—R. WOOD. Dear old Walkinghame—I had quite forgotten his rules (usually very bad); but certainly those you quote for division of decimals are pretty good, though that is an awkward sentence—"*The quotient must have so many decimal places as the dividend has more than the divisor*"—regarded as a general rule, and in connection with the fact that the dividend may have *fewer* decimal places than the divisor.—GRADATIM. It is the case that any map can be painted in four colours, whatever the number and arrangement of divisions—only there must not be, as in England in counties, a part of any one county, country, or shire within another or separated from the main body. The proof is not very simple—I have forgotten it. Perhaps some reader may remember it. I have not forgotten my promise about precession or limitation of abstrac space. But I have been baffled, so far, by the constant procession of new subjects and the limitation of our concrete space.

## ELECTRICAL.

WILLIAM EVANS'S Swan Lamps can be purchased for 5s. each (support, 1s. extra) of the Swan Electric Light Company, Mosley-street, Newcastle-on-Tyne. To light *one* will be an expensive matter. You require twenty good Bunsen cells, quart size, which can be procured at 5s. each from Orme & Co., Barbican, Townson & Mercer, Bishopsgate-street, Griffin & Co., Long-acre, London, Mottershead & Co., Manchester, or, in fact, any good physical instrument-makers. To buy the parts and make the cells yourself, the cost would be about 3s. 6d. each. These cells will take about 15 lb. of nitric acid (sp. g. 1,420), at 4d. to 6d. per lb., and 4 lb. to 6 lb. of sulphuric acid (good commercial), at 1d. per lb. The battery will last three to four hours, and the nitric acid may be used three times, after which it will be too far spent to be useful. The only other part you require is the wire, the cost of which will, of course, depend on its length.—CONSTANT READER. Originally enormous battery power was used to work Atlantic cables, but a method is now adopted with excellent results. Each end of the cable is connected to a condenser; no current is sent into the cable, the signal being transmitted by charging one side of the condenser from six or eight bichromate cells. This charge (supposing it to be +) induces a − charge on the other side, and a corresponding + charge on one side of the condenser at the remote end of the cable. The other side of the distant condenser becomes charged −ly, this latter induction actuating the receiving apparatus. The resistance of the older cables is about 7,000 ohms, but the more recent ones are a little less.—ELECTRON. The Leclanché cell; see last week's answer to H. Bardsley.—TIMOTHY FISHER. The chloride of silver battery should be charged with a weak solution of ammoniac chloride (sal ammoniac). The zinc dissolves as a chloride, and the chloride of silver is decomposed, the metal attaching in a spongy state to the silver wire, and the chlorine taking the place of that which unites with the zincs.—JAMES GRUNDY. 1. The machine is not calculated to do what you require. You want a machine wound with thick wire, and offering very low resistance; considerably less than one ohm. 2. The machine will not light two Swan lamps, unless they are very small indeed. Before I can attempt to advise any particular dimensions, I must know more about the lamps you mention. What is their reputed candle-power? 3. Two Bunsens in series would be plenty, but your Leclanché will do very well. If the resistance of the coil of wire does not exceed 8 ohms, join the cells in half-series. 4. Your diagram not quite clear. The magnets are of the horseshoe or U form, and should be so placed in the grooves as to make one pole-piece a north pole and the other a south pole. 5. Let the magnets come as closely in contact with the pole-pieces as you possibly can. 6. Jamin magnets increase the power, but you would do better still by using electro magnets. 7. You talk about using a machine where you cannot use a fire for heating purposes. Do not forget that an electric generator used in a coal-mine would, in all cases where naked flame is prohibited, prove disastrous on account of the spark at the commutator. You must send your current into the mine either by means of a wire, or in accumulation.—G. H. MORTIMER. The zinc plate in a Daniell cell should be ⅛ to ¼ of an inch thick. To amalgamate the plate, clean it in a weak solution of sulphuric or hydrochloric acid, then rub a little mercury over it. If the mercury does not adhere, wash the plate again and repeat until thoroughly amalgamated. There are several other methods, but this is the best under the circumstances.

## CHEMICAL.

W. H. B. Your query is not correctly worded; we presume you mean that "the ignition point of ammonia gas is higher than the temperature *produced by* (not required for) its combustion." It is well known that substances have to be heated to a certain point before they will combine; thus, phosphorus, which burns so brightly in oxygen, requires to be raised above the ordinary temperature before the action commences. The heat produced by the union of the first few molecules is so intense that the neighbouring ones are heated beyond the ignition point, and so the burning proceeds vigorously. There are other substances that have very little chemical attraction for each other; consequently their union is productive of very little heat, and also they, as a rule, possess a high ignition point. Now, if one of these substances be heated sufficiently at one point to cause it to burn, as the heat produced is not sufficient to raise the temperature of the

contiguous particles to the ignition point, the burning cannot continue without the continued application of external heat. The combustion of ammonia consists not only of combination, but also of separation, of atoms. The chemical change is represented by $4NH_3 + 3O_2 = 2N_2 + 6H_2O$, the hydrogen combines with oxygen, and nitrogen is liberated. The heat produced by the combustion of the hydrogen is, in great part, used up in dissociating that element from the nitrogen. For this reason the ignition point is high, and the sensible heat of combustion low.—W. P. Provided the combustion of coal gas is complete, precisely the same amount of heat is generated, whether the gas be burned from a Bunsen, or an ordinary luminous gas-burner. In the latter case, however, the combustion rarely is complete, as witness our smoky ceilings. Where the flame is used for heating, say a kettle of water, the Bunsen is more efficient, because it deposits no soot; any such deposit acts as a non-conductor of heat, and further represents fuel that ought to have been burned up. Again, a luminous flame radiates heat as well as light, and this is another source of loss. In gas cooking-stoves, meat is roasted by the radiant heat, and here small luminous jets are always employed above and around the joint, but not under. The advantage of the Bunsen under certain circumstances depends, not on its possessing a power of producing absolutely more heat, but on its producing it in a form more applicable to the purpose on hand. If instances are wanted of the densest ignorance of the elementary laws of heating, glaring examples can usually be found in any exhibition of cooking and heating-stoves.—CERTO. "Dulong and Petit, who were the earliest investigators on the subject, contended that all elementary atoms have the same capacity for heat, or, in other words, that the specific heats of all elementary atoms are the same. If this law be admitted, it is obvious that the determination of the specific heat of an element must furnish a ready means of fixing its atomic weight." (Watts's Dictionary.) This explains Frankland's rule; since 7 is the atomic weight of lithium, "the weight of any other element in the solid condition which at the same temperature contains the same amount of heat, as 7 parts of lithium must be the atomic weight." This rule is particularly useful in determining whether a particular number or a simple multiple of it really represents the weight of the atom. In the case of solids it is often difficult to determine this otherwise. Lithium is conveniently selected as the standard because its atomic weight is low. The rule, with equal propriety, might read, "the weight . . . . . as 24 parts of solid magnesium." Lithium has a specific heat of 0·9408. Bisulphide of carbon ($CS_2$) is a very volatile liquid, having a most disagreeable odour. It is produced by passing sulphur vapour over red-hot charcoal, and also during the decomposition of various organic bodies. We can find no record of this substance being found in coal, or the atmosphere of coal-mines. Carbon bisulphide might be detected in a sample of air from a coal-mine by the following method:—First free the air, in the usual manner, from sulphuretted hydrogen; next pass it in a slow stream through an etherial solution of triethylphosphine, contained in a set of nitrogen bulbs; a reddening of the liquid indicates the presence of the sulphide of carbon. Experiments of this kind require a knowledge of analytic methods and manipulation. Jago's "Inorganic Chemistry, Theoretical and Practical," published by Longmans & Co., at two shillings, will probably suit you. Davis's Geology, in Collin's Elementary Science Series, forms a useful introduction to the study of that science.—G. H. MORTIMER.—Laughing gas is made by heating a small quantity of ammoniac nitrate, which splits up into water or steam and nitrous oxide, or laughing gas. The gas may be collected over water. Mix it with air and breathe for a few minutes.

## Our Mathematical Column.

### EASY LESSONS IN THE DIFFERENTIAL CALCULUS.

No. II.

ILLUSTRATING a *differential coefficient* by the case of a body falling under the action of the constant force of terrestrial gravity, $g$, we supposed the space ($s$) fallen through by a body in a given time ($t$) to be known,—since for the purpose of our illustration it was not necessary to show how $s$ is determined. But it so happens that, in taking this instance to illustrate the *integral* calculus, we have to consider how $s$ is determined, from what, in reality, is all that is known in this case. We know that the force, $g$, being constant, the velocity generated in any time is proportional to the time, so that, if $v$ be this velocity, we may write $v = gt$, suitable units of time and length being taken. (Usually the unit of time is a second, that of length a foot; in which case, $g = 32{\cdot}2$ and $v = 32{\cdot}2t$.)

Now, knowing that $v = g\,t$, we may try the same expedient to determine the space traversed at the end of any time $t$ from rest, as we employed in the inverse problem. We may divide up the time into a number of small parts, and suppose the velocity uniform during each short interval of time. Let us see what comes of this experiment. Take $t = n\,\tau$, where $\tau$ is very small and therefore $n$ very large. Then, at the beginning of the $r$th interval, the velocity is $(r-1)\,g\,\tau$, and at the end of this interval the velocity is $r\,g\,\tau$. Thus the space traversed in the interval lies between $(r-1)\,g\,\tau^2$ and $r\,g\,\tau^2$. Doing this for all the intervals, and adding, we find that the total space traversed in time $n\,\tau$ or $t$ lies between

$$\left.\begin{matrix}[0+1+2+3+\ \ldots\ +(r-1)+\ \ldots\ +(n-1)]g\tau^2\\ \text{and } [1+2+3+\ \ldots\ +r\ \ \ +\ \ldots\ +n\ \ ]g\tau^2\end{matrix}\right.$$

or between

$$\frac{n(n-1}{2}\,g\tau^2 \text{ and } \frac{n(n+1)}{2}\,g\tau^2$$

or (writing for $\tau$ its equivalent $t \div n$) between

$$\frac{n^2-n}{2n^2}\,gt^2 \text{ and } \frac{n^2+n}{2n^2}gt^2$$

*i.e.*

$$\frac{gt^2}{2} - \frac{gt^2}{2n} \text{ and } \frac{gt^2}{2} + \frac{gt^2}{2n}$$

The larger $n$ is the smaller is the second term of each expression. But we may have $n$ as large as we please, and so bring these two expressions as near to each other in value as we please. This means, of course, that the true value of each, when $n$ is infinite, is

$$\frac{gt^2}{2}$$

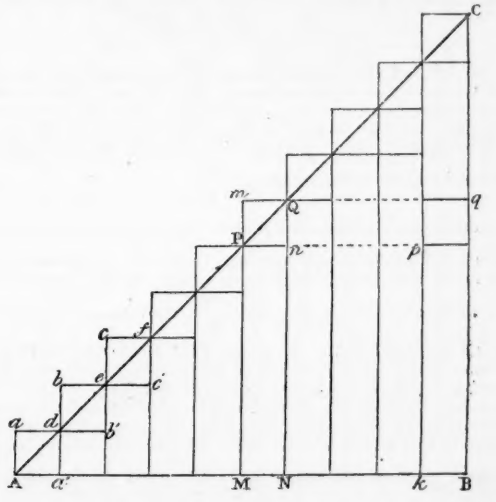
This, then, is the space traversed in time $t$ by a falling body starting from rest, under the action of terrestrial gravity. That is, we have established the relation

$$s = \frac{gt^2}{2}$$

using for the purpose what may be regarded as an algebraical artifice—in reality, disguised integration.

Before showing how this process illustrates integration, let us examine Newton's geometrical way of dealing with a problem such as the above. *Note how cumbersome both processes are.*

Let the time $t$ be represented by the straight line A B, and the velocity acquired at the end of time $t$ (from rest), by the straight line B C at right angles to A B. Now suppose A B divided into a number of small equal parts, say into $n$ parts, each equal to M N; and from all such points as M, N set up straight lines M P, N Q at right angles to A B, and each taken to represent the velocity at the end of the times represented by A M, A N, &c., respectively. Since the velocity is proportional to the time, it is obvious that all such points as P and Q will lie on the straight line A C (for, otherwise, we should not have P M : Q N : B C, &c. :: A M : A N : A B).




Now, if we suppose the falling body to move during any small portion of time represented by M N, with the velocity at the beginning of that time, represented by P M, the space traversed by the body in that interval would be represented by the rectangle P N; whereas, if the falling body moves during this interval with the velocity acquired at the end of it, represented by Q N, the space traversed will be represented by the rectangle $m$ N.

The area, then, representing the space actually traversed lies somewhere between the two rectangles P N and $m$ N. Thus the total space described in time $t$ is represented by an area less than the area between A B, B C and the outer zigzag A $a$ $d$ $b$ $e$ $c$ $f$, &c., and greater than the area between A B, B C and the inner zigzag $a'$ $d$ $b'$ $e$ $c'$ $f$, &c. These areas differ from each other by the sum of the small parallelograms $aa'$, $bb'$, $cc'$, &c. Now, although when $n$ is made very great, and therefore each rectangle like $mn$ very small, the number of such small rectangles is very great, this by no means prevents their sum becoming very small. For sliding the rectangle $mn$ along to the base AB to the position $pq$, and doing the like for all the small parallelograms, we have them finally covering the rectangle C$k$; and the area of this rectangle becomes as small as we please, when, $n$ being taken as large as we please, $k$B becomes as small as we please. Therefore the area of the triangle ABC, which lies between the two just named, may be made to differ from either by an area less than any that can be assigned; and this is the same as saying that this area correctly represents the space fallen though from rest under the action of gravity. Now AB$=t$, and BC$=gt$.

Hence area ABC$=\frac{gt^2}{2}$. And $s=\frac{gt^2}{2}$.

[The reader must not fall into the mistake of supposing that we are here equating a distance to a triangle. AB represents a period of time, and BC a velocity,—in this way only, that the number of units of length in AB are supposed to correspond to the number of units of time in $t$, &c. Just as we get the right *number* for the square feet in a rectangle by multiplying the *numbers* representing the lengths of the sides, though feet cannot be multiplied by feet to give square feet, so here we get a correct *numerical* result, by using the lengths of lines to represent numbers.]

Now, in each of the above processes, we have employed an artifice, algebraical in one case, geometrical in another, to obtain a result such as the integral calculus obtains in a systematic manner.

We know in this case that the velocity at the end of any time $t$ is $g\,t$, or, in other words, that the rate at which the space traversed is increasing, after time $t$ has elapsed from rest, is $g\,t$. Now, we showed in Paper I. that the differential coefficient of $\frac{g\,t^2}{2}$ with respect to $t$ is $g\,t$, explaining this to mean that the rate of increase of the expression $\frac{g\,t^2}{2}$ with the variation of $t$ is represented by $g\,t$.

Supposing, then, that, in dealing with the fall of a body under gravity, we know velocity at time $t$ from rest,—or the rate of increase of $s$, the space traversed, at this time,—to be $gt$, and also know that $gt$ is the differential coefficient of $\frac{gt^2}{2}$ with respect to $t$,—we can at once write

$$s=\frac{gt^2}{2}\pm\text{some constant.}$$

(It has not, indeed, been yet shown that two quantities can only have the same differential coefficient when they are either equal or differ by a constant quantity; but for the present this is assumed, as we are now only illustrating the nature and use of differential coefficients, &c.) And as when $t=0$, $s=0$, the constant must be zero. So that we have, simply, $s=\frac{gt^2}{2}$.

In other words, from our knowledge that $\frac{gt}{2}$ is the quantity having $gt$ for its differential co-efficient with respect to $t$, we are at once able to say that a falling body whose velocity at time $t$ is $gt$, will in time $t$ from rest traverse the space $\frac{gt^2}{2}$. The notation employed for stating this is as follows. Note that what we have to determine is the sum of the spaces described in the infinitely small intervals of time into which the whole time $t$ is supposed divided; in other words a number of the sum of all small spaces, each represented by $gt.\Delta t$ where $\Delta t$ is the increment of the time. This sum, which we should represent by $\Sigma gt.\Delta t$, were the number of spaces not infinite, is in the integral calculus represented by $\int gt.dt$, when the number is infinitely great and $\Delta t$ infinitely small, and we write

$$\int gt.dt=\frac{gt^2}{2}+\text{a constant.}$$

How we find the sum corresponding to particular limiting values of the variable will be shown further on.

Of course, we have here selected a case where we knew beforehand that quantity of which the simple expression we were dealing with is the differential coefficient. In other cases, we might have more or less trouble to determine this; but a great number of differential coefficients are known, and in every such case we can at once write down the expressions of which they are the differential coefficients—or, in other words, we can at once solve our problem. For other cases there are methods by which either an exact or approximate solution can be readily worked out.

To sum up the elementary points thus far illustrated:—*When there is a quantity whose value depends on some variable, the differential coefficient of the quantity with respect to that variable represents the rate at which the quantity varies as the variable changes in value.*

*When we know the rate at which a quantity depending on some variable changes with change of the variable—in other words, when we know the differential coefficient of the quantity with respect to that variable—we can determine the quantity itself, if only we know what quantity it is which has that differential coefficient.*

When we have indicated how the differential coefficients of a number of expressions can be determined, the importance of these points will be recognised.

(*To be continued.*)

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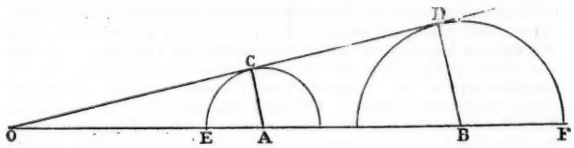
PROBLEM 44.—We prefer to solve this problem in the following general form, as more instructive than a special case:—




*Let* AC, BD, *the radii of two drums, be respectively* $a$ *and* $b$ $(b>a)$; *and let* AB $=d$, *required the length of belting necessary for them.*

Let OCD be a common tangent meeting BA produced in O. Then,

$$\text{OA}=\frac{a}{b-a}.\,d=p\text{ say}$$

and

$$\text{CD}=\frac{\text{OC}}{\text{OA}}\,d=\frac{\sqrt{p^2-a^2}}{p}.\,d$$

$$\text{arc EC}=a\sin^{-1}\left(\frac{a}{p}\right)$$

$$\text{arc DF}=b\left[\pi-\sin^{-1}\left(\frac{a}{p}\right)\right]$$

Hence length of belting required $=2$ (arc EC + CD + arc DF) is known.

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THE POISONOUS CONSTITUENTS OF TOBACCO-SMOKE.—A series of experiments has been recently conducted by Herr Kissling, of Bremen, with the view of ascertaining the proportions of nicotine and other poisonous substances in the smoke of cigars. His paper, in *Dingler's Polytechnisches Journal*, gives a useful *résumé* of the work of previous observers. He specifies, as strongly poisonous constituents, carbonic oxide, sulphuretted hydrogen, prussic acid, picoline bases, and nicotine. The first three occur, however, in such small proportion, and their volatility is so great, that their share in the action of tobacco-smoke on the system may be neglected. The picoline bases, too, are present in comparatively small quantity; so that the poisonous character of the smoke may be almost exclusively attributed to the large proportion of nicotine present. Only a small part of the nicotine in a cigar is destroyed by the process of smoking, and a relatively large portion passes off with the smoke. The proportion of nicotine in the smoke depends, of course, essentially on the kind of tobacco; but the relative amount of nicotine which passes from a cigar into smoke depends chiefly on how far the cigar has been smoked, as the nicotine-content of the unsmoked part of a cigar is in inverse ratio to the size of this part, *i.e.*, more nicotine the shorter the part. Evidently, in a burning cigar, the slowly-advancing zone of glow drives before it the distillable matters, so that in the yet unburnt portion a constant accumulation of these takes place. It would appear that in the case of cigars that are poor in nicotine, more of this substance relatively passes into smoke than in the case of cigars with much nicotine; also that nicotine, notwithstanding its high boiling point, has remarkable volatility.—*Times.*

# Our Chess Column.

By MEPHISTO.

## VIENNA INTERNATIONAL TOURNAMENT.

COMPLETE SCORE LIST.

| | Bird | Blackburne | Englisch | Fleissig | Hruby | Mackenzie | Mason | Meitner | Noa | Paulsen | Schwarz | Steinitz | Tschigorin | Ware | Weiss | Winawer | Wittek | Zukertort | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bird | — | 01 | 00 | 01 | 10 | 01 | 2½ | 10 | ½1 | ½0 | 00 | 00 | 00 | 11 | 10 | 00 | ½0 | 00 | 12 |
| Blackburne | 10 | — | ½½ | 11 | 10 | 01 | ½½ | 11 | 01 | 0½ | 1½ | 01 | 11 | 11 | 01 | 01 | 10 | 1½ | 21½ |
| Englisch | 11 | ½½ | — | ½1 | ½½ | ½0 | ½½ | 01 | 11 | 11 | ½½ | ½½ | 0½ | 11 | ½½ | 00 | ½0 | 1½ | 19½ |
| Fleissig | 10 | 00 | ½0 | — | 00 | 00 | ½0 | 00 | ½0 | ½0 | 00 | 00 | 10 | 00 | 00 | 10 | 00 | 10 | 6 |
| Hruby | 01 | 01 | ½½ | 11 | — | 00 | 10 | 11 | 01 | ½0 | ½½ | 10 | 10 | 10 | 1½ | 00 | 10 | 00 | 16 |
| Mackenzie | 10 | 10 | ½1 | 11 | 11 | — | ½0 | 11 | 11 | 1½ | 01 | ½0 | 01 | 1½ | 11 | 1½ | ½0 | ½½ | 22½ |
| Mason | 0½ | ½½ | ½½ | ½1 | 01 | ½1 | — | 1½ | 01 | 11 | ½1 | ½½ | 11 | 11 | 10 | 11 | 11 | 0½ | 23 |
| Meitner | 01 | 00 | 10 | 11 | 00 | 00 | 0½ | — | 01 | ½0 | ½1 | 00 | 11 | 01 | 1½ | 00 | ½½ | 00 | 19 |
| Noa | ½0 | 10 | 00 | ½0 | 10 | 00 | 10 | 10 | — | ½0 | 10 | 00 | 10 | 10 | 00 | 00 | ½0 | 00 | 9 |
| Paulsen | ½1 | 1½ | 00 | ½1 | ½1 | 0½ | 00 | ½1 | ½1 | — | ½1 | 00 | 11 | 11 | ½1 | 01 | 1½ | 00 | 18½ |
| Schwarz | 11 | 0½ | ½½ | 11 | ½½ | 10 | ½0 | ½0 | 01 | 0½ | — | 00 | 0½ | ½1 | 11 | ½½ | 00 | ½½ | 15½ |
| Steinitz | 11 | 10 | ½½ | 11 | 01 | ½1 | ½½ | 11 | 11 | 11 | 11 | — | 10 | 01 | 1½ | 11 | 01 | 0½ | 24 |
| Tschigorin | 11 | 00 | 1½ | 01 | 01 | 10 | 00 | 00 | 01 | 00 | 1½ | 01 | — | 1½ | 00 | 00 | 0½ | 10 | 13 |
| Ware | 00 | 00 | 00 | 11 | 01 | 0½ | 00 | 10 | 01 | 00 | ½0 | 10 | 0½ | — | 11 | 00 | 0½ | 00 | 10 |
| Weiss | 01 | 10 | ½½ | 11 | 0½ | 00 | 01 | 0½ | 11 | ½0 | 0½ | 0½ | 11 | 00 | — | 0½ | ½1 | 11 | 16½ |
| Winawer | 11 | 10 | 11 | 01 | 11 | 0½ | 00 | 11 | 11 | 10 | 11 | 0½ | 11 | 11 | 1½ | — | 01 | 1½ | 24 |
| Wittek | ½1 | 01 | ½1 | 11 | 01 | ½1 | 00 | ½½ | ½1 | ½½ | ½½ | 10 | 1½ | 1½ | ½0 | 10 | — | 00 | 18½ |
| Zukertort | 11 | 0½ | 0½ | 01 | 11 | 1½ | 1½ | 11 | 11 | 11 | 01 | 1½ | 01 | 11 | 00 | 0½ | 11 | — | 22½ |

### SECOND GAME OF THE TIE PLAYED ON JUNE 24.

| WHITE. Winawer. | BLACK. Steinitz. | WHITE. Winawer. | BLACK. Steinitz. |
|---|---|---|---|
| 1. P to K4 | P to K4 | 35. R to QRsq | K to K4 |
| 2. KKt to B3 | QKt to B3 | 36. P to KR3 (*o*) | R to R5 (*p*) |
| 3. QKt to B3 | P to KKt3 | 37. P to B3 | B to B5 |
| 4. P to Q4 | P takes P | 38. B to B2 (*q*) | R to R3 |
| 5. Kt takes P | B to Kt2 | 39. P to KKt4 (*r*) | P to R5 |
| 6. Kt takes Kt | KtP takes Kt | 40. P to R4 | R to Kt3 |
| 7. B to Q3 | Kt to K2 | 41. R to QKtsq (*s*) | R takes R |
| 8. Castles | P to Q3 | 42. B takes R | B to B 8 |
| 9. Q to Ksq (*a*) | Castles | 43. K to B3 | P to Kt4 (*t*) |
| 10. P to B3 | P to KR3 | 44. B to R2 | P to B3 (*u*) |
| 11. B to K3 | K to R2 | 45. B to B7 | B to Q6 |
| 12. Q to Q2 | P to KB4 | 46. K to B2 (*v*) | K to B5 |
| 13. QR to Ksq | P takes P (*b*) | 47. P to R5 | B takes P (*w*) |
| 14. P takes P | R takes R (ch) | 48. B to B4 | P to Q4 |
| 15. R takes R | B to K3 | 49. B to R6 | P to B4 |
| 16. Kt to K2 | P to B4 | 50. B to B8 | P to B5 |
| 17. Kt to B4 | B to Ktsq | 51. P to R6 | K to K4 |
| 18. P to QKt3 | Q to Q2 | 52. B to Q7 | P to Q5 |
| 19. R to B3 | R to KBsq | 53. P takes P (ch) | K takes P |
| 20. R to R3 | B to B2 (*c*) | 54. K to K2 | B to Q6 (ch) |
| 21. Kt to Q5 (*d*) | P to R4 (*e*) | 55. K to Ksq | P to B6 |
| 22. Kt takes Kt (*f*) | Q takes Kt | 56. B to B8 | K to K6 |
| 23. R to B3 | K to Ktsq (*g*) | 57. K to Qsq | K to B7 |
| 24. QB to Kt5 (*h*) | Q to K4 (*i*) | 58. B to B5 | B takes P |
| 25. B to R6 | R to Ksq (*j*) | 59. K to B2 | B to B8 |
| 26. B takes B | K takes B | 60. K takes P | B takes P |
| 27. Q to B4 (*k*) | Q takes Q | 61. K to Q4 | B to Kt7 |
| 28. R takes Q | P to B5 (*l*) | 62. K to K5 | P to R6 |
| 29. P takes P (*m*) | R to K4 | 63. K to B6 | P to R7 |
| 30. R to Bsq | R to QB4 (*n*) | 64. K takes P | P to R8Q |
| 31. K to B2 | B takes P | 65. K to Kt6 | K to B6 |
| 32. K to K3 | B to K3 | 66. P to Kt5 | K to B5 |
| 33. R to QKtsq | K to B3 | Resigns. | |
| 34. P to QR3 | R to R4 | | |

Notes by Herr Steinitz, from the *Field*.

(*a*) Not a good post for the Q. Herr Winawer probably intended to support his Kt, in order not to be subjected to the doubling of his QBP, while reserving the choice of squares for his QB.

(*b*) He isolates the adverse P, but he exposes himself to an attack which he afterwards finds somewhat troublesome, and which subsequently required the greatest care in defending.

(*c*) Probably the only move. It makes room for his K, and liberates his Kt for action; the latter could not move at once; for White would have sacrificed the Kt for the KtP, which Black could not venture to retake with the K, on account of the rejoinder, P to K5 (dis. ch).

(*d*) White is not to be tempted into sacrificing the Kt, whereupon the game might have proceeded thus:—

| WHITE. | BLACK. | WHITE. | BLACK. |
|---|---|---|---|
| 21. Kt takes P | Kt takes Kt | 22. B takes RP | R to KRsq, and should win. |

(*e*) Again the only move; if Kt to Kt sq, White could still take off the RP, for if the B retook, the reply R takes B(ch) would win, since the Kt could not retake, on account of Kt to B6(ch); if, however the Kt then took the B, White would mate in a few moves, commencing with Kt to B6(ch).

(*f*) White judiciously gives up all attack which he could not sustain; for instance, by P to KKt4—since Black would then pin the P by B to K3, and afterwards Q to Q2.

(*g*) First part of a plan for inducing the opponent to exchange pieces and to bring about an ending.

(*h*) With the view of driving the Q to K4, and in order to be enabled to oppose Queens at KB4 subsequently.

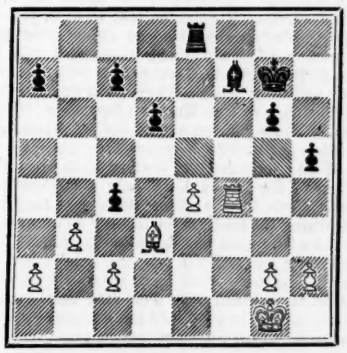
(*i*) She cannot retreat to Q2, as the B would be opposed at B6 with advantage.

(*j*) It would have been very unwise to check with the Q at R8, and then to take the QRP; White would interpose the R, followed by B takes B, Q to B3(ch), and R to Rsq, with an excellent game. The move in the text is another preparation for this game in the ending, as will be seen on Black's 28th and 29th move.

(*k*) The offer of exchanging Queens is ill advised; White would have had a perfectly even game otherwise. Herr Winawer subsequently admitted that he had ignored the effect of Black's next move after exchanging.

(*l*) This move exercises a most important effect on Black's prospects in the ending, for it forces the separation and isolation of White's Pawns on the Q side.

Steinitz.
BLACK.



WHITE.
Winawer.

(*m*) He could not evade the unpleasant necessity of capturing, for, if he moved the B to K2, Black would still answer R to K4; threatening R to QR4, and also to win a P at once by P to KKt4.

(*n*) Stronger than R to QR4, *e.g.*:—

| WHITE. | BLACK. | WHITE. | BLACK. |
|---|---|---|---|
| 30. | R to QR4 | 34. R to QB7 | R takes P |
| 31. R to Ktsq | K to B3 | 35. P to K5 | P takes P |
| 32. R to Kt7 | P to B4 | 36. B to K4, with a strong attack. | |
| 33. R to Q7 | K to K3 | | |

(*o*) Not a good move; P to QB3 was better.

(*p*) Black threatens now to bring the B round to QB3 *vid* Q2.

(*q*) Obviously he could not afford to exchange, as his separated Pawns would soon fall, one by one.

(*r*) This compromises the position of his Pawns on the K side, too; as, after the exchange of Rooks, which is soon inevitable, they are all placed on squares on which they can be attacked by the hostile B.

(*s*) He could not afford to allow the R to reach Kt7, as his two pieces and the K would be too much confined, and an unfavourable exchange of Bishops could be easily forced, after which the R would gain access at KR7, taking the KRP.

(*t*) Better than taking the P, whereupon White would have blocked in the B by B to Q3.

(*u*) Necessary in order to prevent the adverse B from reaching Q5, and then defending alternately by B to B6, Kt5, or Q5 accordingly.

(*v*) Perhaps in the hope that Black might take the P with the K,

XUM

whereupon White would win a piece by B to Kt6(ch). He could, however, no more protect the P; if B to Kt6, Black could advance P to Q4.

(*w*) Black has it all his own way after this, and rests easy.

## ANSWERS TO CORRESPONDENTS.

*** *Please address Chess-Editor.*

T. Gillespy.—Problem 45. If 1. R to R3, 1. P takes B, and there is no mate.

A. A. B.—Game received: will appear as soon as possible.

Problem 45 correctly solved by Moleque, Senex Solitarius, Francis J. Drake.

# Our Whist Column.

BY "FIVE OF CLUBS."

## RETURNING PARTNER'S LEAD.

THERE is scarcely any more obnoxious rule at Whist than that which many good players of their own hands insist upon, that partner's lead should almost always be at once returned. The player who always returns your lead at once is more annoying even than the one who, when the right time has come for returning it, insists on keeping to his own suit. I would even take exception to Cavendish's rule that "with only moderately strong suits, which you open to a disadvantage, you do better to return your partner's original suit, or to lead up to the weak suit of your right-hand adversary, or through the strong suit of your left-hand adversary," than to open your best suit,—*unless* by the words, "which you open to a disadvantage," he means to qualify the expression, "moderately strong suits," and not (as it seems) to make a statement respecting such suits. It is clear that, with only weak three-card suits outside trumps, you do better to return your partner's suit than to lead one of your own. On the other hand, with a tolerably strong three-card suit, headed by a sequence, you do better to lead your own suit. With a four-card suit headed by anything below a Knave, you might return him his suit; but with such a suit as Knave, nine, eight, three, you ought in my opinion, to show your own suit before returning his—especially if you have good cards in your short suits, so as to have a good chance of an opportunity to lead again to him. This is always to be considered; for if you have only a moderately good long suit, and weak cards in the other suits, you may have but one chance of returning his lead, while it may be of great importance that he should be led to, and not have to lead himself. Besides, he may have a strong suit, which may be established if he gets a return lead, and he may then lead trumps, and make a great game; whereas, if you lead your own moderately strong suit, you almost certainly throw the play into the adversaries' hands.

There are some cases, however, where, even when you have a strong suit, you should at once return your partner's lead. Thus, if after taking the trick you remain with the leading card in his suit (which the play shows to be strong), you should play out that card in order to clear his suit. Again, if you held originally only two in his suit, and are weak in trumps, you should return his lead, so that, if he can, he may lead the suit a third time for you to trump it; for in this way you help him to clear his suit, while using a trump which otherwise would probably fall uselessly.

When the adversary to your left has shown great weakness in your partner's suit, as by failing to head a nine, ten, or Knave of your own at the first round, it is generally unsafe to return the lead; for the strength must lie between your partner and the player to your right, so that you are probably leading up to strength. Your partner will, indeed, lead under not very favourable conditions, as you also have shown weakness, so that the player to your right will stand to your partner (leading) much as fourth player usually stands to third. But he will not be quite so badly off as when you lead to him; for the card first played by you third in hand may be the lowest of a sequence, for aught the player to your right can generally know.

The most important rule, in returning partner's lead, and one of the most important general rules at Whist, is to return the highest of two remaining cards, the lowest of three or more. The only exceptions to this rule are that (1) with the winning card and two others (left after first round) you lead the winning card, and (2), with second and third best and another (after first round), you lead the second best, not the small one. With these exceptions (and an occasion or two, perhaps, where your partner is utterly weak, and you wish to deceive the enemy), this rule is imperative, and extends throughout the whole range of the suit. Thus, with 4, 3, left after first round, the return of the 3 would be a gross Whist blunder, as would be the play of the 4, if, besides the 4 and 3, you hold the 2 also. In these cases nothing is directly gained or lost by the lead of 4 or 3. Yet the rule had its origin in considerations of play. For with such cards as Queen and a small one, or Knave and a small one (after first round), the lead of Queen or Knave is manifestly good policy; for thereby you strengthen your partner: you are numerically weak in the suit, and most probably lose nothing yourself; whereas with Queen and two small ones, or Knave and two small ones (after first round), you do well to keep back the Queen or Knave, being numerically strong, and having a fair chance of not only making the honour, but remaining with the best card in the suit after three rounds.

In trumps, this rule is even more important than in plain suits. The whole strategy of the game may be ruined by your telling your partner (as you do in returning his lead wrongly) that you held originally only three trumps when you really held four, or that you held four when in reality you only held three.

A player who neglects this general rule, of which, of course, no Whist player is ignorant, can only be regarded as a very poor player indeed. Scarcely inferior is the player who, when this signal is given him, fails to notice it, or who overlooks it when it occurs in the play of his adversaries. Omitting to notice the signal for trumps either in partner's or adversaries' play is in comparison a small offence.

DOUBLE DUMMY PROBLEM.—Lieutenant-Colonel Drayson gives the following ingenious little double dummy puzzle:—Give the adversaries four by honours in every suit; give yourself and partner any of the other cards you choose, and win five by cards against them, you to have the lead.

VALUE OF GOOD PLAY.—A correspondent, as a further proof that good play must tell, gives us his experience, which was carefully taken down. In two years' play, he tells us that the first year he played 2,069 rubbers, winning 1,097 and losing 972, leaving a balance of 125 to the good, and, counting points, he won 5,893 and lost 5,233—a balance of 660 to the good. And in the next year he played 1,626 rubbers, winning 855 and losing 771, or a credit of 84 rubbers, the points being 4,701 wins, 4,159 losses—showing balance of 552 to the good. In the previous year he played 2,029 rubbers, winning 1,107 and losing 922, leaving 185 balance on the winning; but that year he did not keep a record of points. This is, of course, a much higher winning average than Cavendish's; but, as our correspondent admits the inferiority of his player compared to Cavendish, probably the element of luck steps in here. He adds that, in his long experience of play, there was never a week, scarcely even a sitting, that he did not see at least one rubber lost by bad play or won by good.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